Current Science

Vol. XX] MARCH 1951 [No. 3

	Page
The Luminescence of Diamond—IV —Sir C. V. Raman	55
Human Biology and Social Welfare ..	60
Archives of Biochemistry and Biophysics	60
Papyrographic Studies on the Degradation Products of Nucleic Acids— B. Bheemeswar and M. Sreenivasaya ..	61
Soil Conservation—A Vital Need of the Nation	63
The Role of Salientia in Human and Mammalian Pregnancy Tests	64
Planning for Prosperity	64
Letters to the Editor	65
Directory of International Scientific Organizations	75
Reviews	76
Science Notes and News	82

THE LUMINESCENCE OF DIAMOND—IV

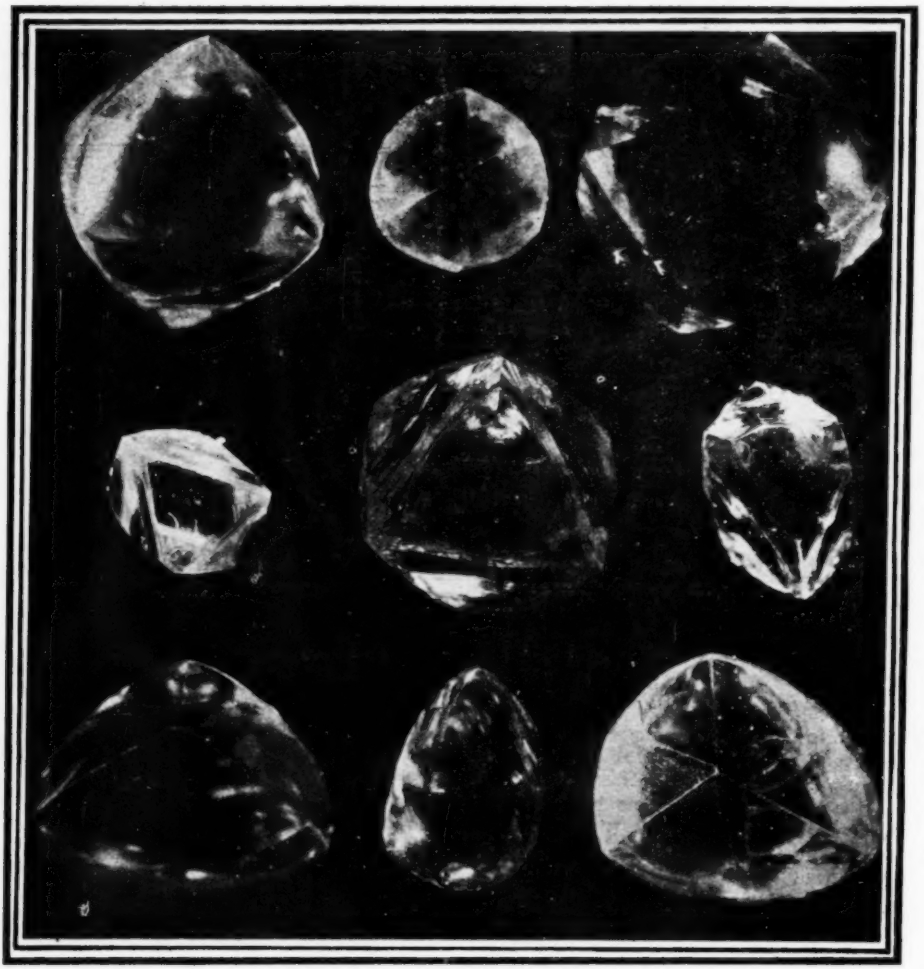
Sir C. V. RAMAN

1. Structure and Crystal Symmetry of Diamond

THE clue to an understanding of the luminescence of diamond is to be sought for in the relationship between the spectroscopic properties of the material on the one hand and its crystal structure on the other. Of fundamental importance in this respect is a result which emerged from the Bangalore investigations, namely, that the diamonds which are the most perfect as indicated by their freedom from birefringence and by the low intensity and extreme sharpness of their X-ray reflections are those which most prominently exhibit the infra-red absorption of the first-order between 7μ and 14μ, and the series of sharply-defined absorption lines in the ultra-violet spectrum between λ 2250 and λ 3500. *Per contra*, the diamonds which do not manifest either the infra-red or the ultra-violet absorption in these regions are those which exhibit the maximum of imperfections in their crystal structure, as indicated by the birefringence which they display and the intense and diffuse X-ray reflections which they give. These facts preclude us from ascribing the activity in infra-red and ultra-violet absorption present in one case and absent in the other to irregularities in crystal structure, and compel us to recognise that there is, in fact, a fundamental difference in structure between the two varieties of diamond. Spectroscopic theory enables us to specify the nature of such difference. If the electronic structure of diamond possesses centres of symmetry located at the points midway between every pair of neighbouring carbon atoms in the crystal lattice, the diamond would necessarily be infra-red inactive in the first-order vibration spectrum. But, if on

the other hand, such centres of symmetry are absent, the diamond would necessarily exhibit an infra-red activity of the first-order. Such a fundamental difference in electronic structure may be expected also to manifest itself in a notable difference in respect of ultra-violet absorption, as is indeed actually observed.

I II III



A

B

C

FIG. 1. Photographs of Diamond Crystals

Thus, spectroscopic theory leads us to recognise the existence of two varieties in the crystal structure of diamond possessing respectively tetrahedral and octahedral symmetry. It may be remarked that the infra-red activity present in one case and absent in the other is very feeble compared with the infra-red activity of crystals having a heteropolar constitution. It is also necessary to point out that the lower symmetry of the infra-red active diamond, whatever may be its origin, would not necessarily involve either piezo-electric or pyro-electric activity. The feebleness of the infra-red activity is itself also an indication that the differences in structure between the tetrahedral and octahedral varieties when expressed in quantitative measure are very small. It is, therefore, not surprising that the two varieties of diamond make a very close approach to each other in many of their physical properties. Such similarity has another

important consequence. Since both structures belong to the cubic system, we should expect that their appearance side by side in the same specimen of diamond should be a very frequent occurrence. That this is indeed actually the case is shown by the frequency with which patterns of ultra-violet transparency are observed in cleavage plates of diamond, as already mentioned in an earlier article of the series. These patterns always exhibit a geometric character, the boundaries of separation between the opaque and transparent regions running parallel to the octahedral or dodecahedral planes in the crystal lattice. This is ocular evidence that we are concerned with a real difference in structure between the areas under consideration.

2. The Crystal Forms of Diamond

It is well known that crystals of the tetrahedral class in the cubic system frequently exhibit interpenetration twinning, as the result of which their external forms imitate or mimic octahedral symmetry. It follows that such interpenetration of the positive and negative tetrahedral forms should be commonly observable in crystals of diamond. This is fully borne out by experience. Indeed, from the very beginnings of crystallographic science, it had been noticed by mineralogists that the evidence presented by the crystal forms of diamond very definitely placed this substance in the tetrahedral class and indicated a strong disposition on its part to imitate octahedral symmetry by interpenetration twinning.

Fig. 1 reproduces photographs of nine crystals from the Bangalore collection which illustrate the tendency of diamond to exhibit pseudo-octahedral forms as the result of internal twinning. Five of the diamonds, *viz.*, A I, A II, C I, C II and C III are from Panna in Central India and have the rounded forms with smooth lustrous faces characteristic of the finest diamonds from that locality. They also show a feature which is highly characteristic of diamonds with curved surfaces, namely a pattern of sharp ridges which run along the six reflection planes of tetrahedral symmetry and divide the external area into 24 triangular areas (see for instance, A II, which is a nearly spherical diamond). A I, which is octahedral in its general shape, exhibits six sharp vertices where four ridges meet, while at each of its eight face-centres, six ridges meet: but the edges characteristic of a real octahedron are missing, being replaced by smoothly curved surfaces. On the other hand, the diamonds pictured in C I, C II and C III, have forms in which the features characteristic of a hexakis-tetrahedron may be readily recognised, C I being the best example in this respect in the collection. The three diamonds reproduced as B I, B II, B III illustrate another typical form of diamond, *viz.*, octahedra with plane faces and grooved edges. B II (the central picture in Fig. 1) is a particularly fine example of this class from South Africa. It exhibits sharply-defined re-entrant edges which limit the faces of the octahedron and give them a hexagonal instead of a triangular outline. The form is very clearly a consequence of the interpenetration twinning of positive and negative hexakis-tetrahedra.

3. The Origin of the Blue Luminescence

The existence of interpenetration twinning in the tetrahedral type of diamond which is demonstrated by the study of its crystal forms allows us to offer an intelligible explanation of the observed association of blue luminescence with this particular variety of diamond. Every boundary within the crystal at which the positive and negative tetrahedral structures meet is a discontinuity in the crystal structure. The finer the subdivision of the entire volume of the crystal between the two interpenetrating structures, the more numerous would be the possible centres of luminescence brought into existence thereby. The interpenetration of the positive and negative tetrahedral forms thus furnishes a mechanism for the production of luminescence centres in greater or less number and, therefore also for a highly variable intensity of emission as between different specimens or within the volume of any given diamond, as is actually observed.

If the blue luminescence arises in the manner stated above, it follows that an increased intensity of luminescence would necessarily mean an increase in the lack of perfect homogeneity in the lattice structure of the crystal. In other words, the more intense the luminescence which a diamond displays, the less perfect would it be as a crystal. This consequence was actually foreseen by the present writer before X-ray studies confirmed its reality. In particular, an investigation by Dr. G. N. Ramachandran established the existence of a quantitative relationship between fluorescence intensity and the characters of the X-ray reflections by the lattice planes of the crystal, *viz.*, their intensity and their angular range.

A further consequence of the idea that interpenetration of the positive and negative tetrahedral forms is the origin of the blue luminescence may also be pointed out. If the subdivision of the crystal by such interpene-

tration is carried far enough, we should expect the behaviour of the diamond to be noticeably altered as the result of the juxtaposition of the oppositely directed tetrahedral structures at their boundaries of separation. In particular, a diamond which exhibits an intense blue luminescence may be expected to differ noticeably in its behaviour in respect of infra-red and ultra-violet absorption from a diamond which shows only a weak luminescence. This, again, has actually been observed. One finds a distinct weakening of the infra-red activity characteristic of the tetrahedral type of structure in the more strongly blue-luminescent diamonds; simultaneously, the sharp absorption lines is the ultra-violet between λ 2250 and λ 3500 tend to become weaker and the diamond as a whole becomes more transparent to that region of the spectrum.

I II III IV

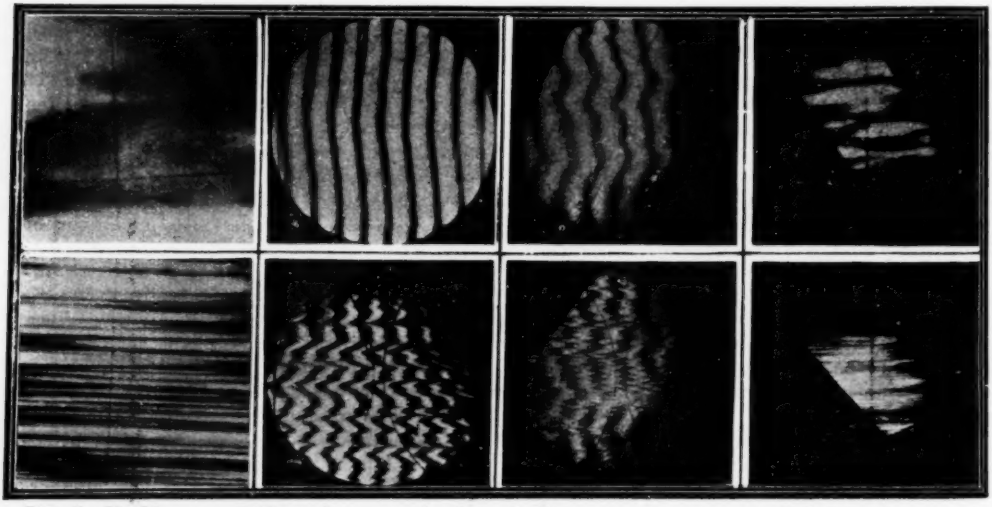


FIG. 2. Birefringence of Diamond as seen in the polarising microscope on the Federov stage: A as viewed normally, and B as viewed under tilt: I and IV without compensator, and II and III with it.

4. THE ORIGIN OF THE GREEN LUMINESCENCE

One need not be surprised that the diamonds having an octahedral symmetry of structure are not luminescent under ultra-violet irradiation. For, they are transparent to radiations of wave-length greater than λ 2250, and if there is no absorption, there can be no re-emission. The origin of the birefringence exhibited by such diamonds becomes clear when a cleavage plate of the same is examined under a polarising microscope provided with a Federov stage. It is then found that the birefringence is due to a lamellar structure running parallel to the octahedral or dodecahedral planes in the crystal. The use of a Babinet compensator in addition reveals that the lamellæ present in the diamond are alternately under tension and compression. It thereby becomes evident that the birefringence arises from the co-existence in the same specimen of two sub-species both having octahedral structures but of slightly different lattice spacings (see Fig. 2).

As already remarked, intergrowths of the octahedral and tetrahedral species of diamond are exceedingly common. Cleavage plates in which there are such intergrowths invariably exhibit birefringence. They also exhibit bands of green luminescence. It is evident that when diamond of the non-luminescent or octahedral type and of the blue-luminescent or tetrahedral type are present side by side in the same specimen, the boundaries between them would represent discontinuities of crystal structure. Since absorption of ultra-violet radiation can occur in the vicinity of such boundaries, there is clearly a possibility of their functioning as centres of luminescence. There is ample experimental evidence to show that the green type of luminescence arises in this way. In the first place, one can understand on this basis why both the blue and green types of luminescence usually appear together, though in varying ratios of intensity. One can also understand why the green luminescence exhibits a banded structure and why there is a perfect

correspondence between such structure and the birefringence pattern observed in the same diamonds. Then again, it is found that when a cleavage plate of diamond showing the banded green luminescence is tilted one way or another, the birefringence and luminescence bands both sharpen in one position and both become diffuse in the other position, showing that they have a common orientation in the crystal. See Fig. 3 in which A and B represent the same cleavage plate photographed in two different directions relative to its surface. I represents the green luminescence bands and II the birefringence.

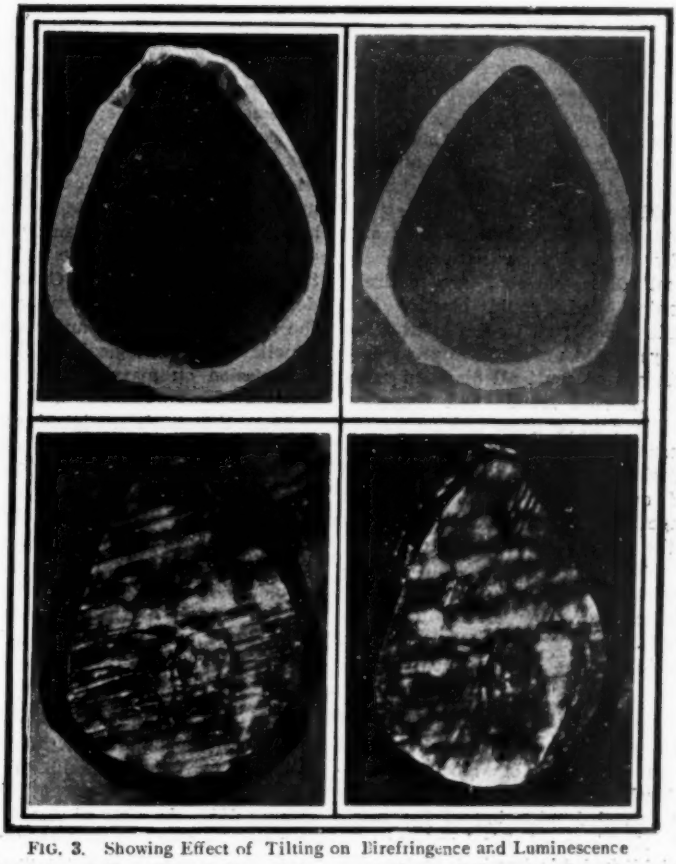


FIG. 3. Showing Effect of Tilting on Birefringence and Luminescence

From measurements of the tilt of the plate necessary to give the maximum sharpness to the bands, it is readily shown that we are concerned with layers running parallel to the octahedral or dodecahedral planes in the crystal, thus affording support to the hypothesis that both the green luminescence and birefringence arise from local variations in crystal structure. We may further remark that the explanation given above for the origin of green luminescence is supported by the observation that the patterns of ultra-violet transparency exhibit a close correspondence with such luminescence. The X-ray topographs also show a great intensity of X-ray reflection along the bands of green luminescence.

5. Concluding Remarks

The foregoing account of the subject has been confined to statements of fact and to interpretations of the same based on well-established principles and therefore of a compelling nature. There are other aspects of the subject which are of interest but being of a somewhat speculative character have not been touched upon

here. For instance, what is the exact nature of the difference in the electronic structures exhibiting respectively tetrahedral and octahedral symmetry? Why are there two subspecies of octahedral symmetry, as is evident from the lamellar structure and birefringence of non-luminescent diamond? We have also not dealt with various other important issues which arise from the facts under consideration. What is the scheme of electronic energy levels in diamond which give rise to the observed emission and absorption spectra? Why are the transitions between them allowed in some cases and forbidden in others? Unless we are in a position to answer such questions, we cannot claim to have fully understood either the structure of diamond or the many fascinating phenomena which it displays.

HUMAN BIOLOGY AND SOCIAL WELFARE

IN his Presidential Address to the Section of Anthropology and Archæology at the 38th Session of the Indian Science Congress, Bangalore, 1951, Dr. Sarkar makes out a case for the role of human biology in the process of building up the welfare state. He lays emphasis on the numerous gaps in our knowledge of the fundamental problems of the science due to long neglect. In many parts of India there is no cumpulsory registration of births, marriages and deaths. The work of the geneticist and the social and civic legislator is thus made difficult by the absence of adequate information and scientific knowledge which could be collected easily by scientific bodies and hospitals. Case reports and clinical data of common diseases such as tuberculosis, venereal diseases, etc., are entirely lacking. A central body could classify and publish such data if collected by the institutions concerned. A system of universal finger printing would settle out of court all disputed cases of identity and prevent frauds and forgeries. Population problems have been tackled so far by alarmist economists and not by sound biologists. Dr. Sarkar is of the view that there is no fear of over-population. The ban on widow marriage in Bengal is depleting the population of the food growers of the country.

Though the work done so far on the menarcheal age of women in India is not conclusive, there are indications to show that the menarcheal age is going down especially in those communities whose socio-economic conditions are better. The Age of Consent Committee's findings in this respect are not satisfactory.

Dr. Sarkar regrets that in no case of disputed paternity have the law courts called in at any time for expert scientific opinion. Drawing up a parallel between the varied aspects of family life in India and the United States, Dr. Sarkar finds that there are many common characteristics of the modern family in both the countries such as urbanization, secularization and a trend to companionship. The only feature in which America differs from India is in the high divorce rate in America with its basic instability of the family, a feature which will become characteristic of India as well on the passing of the Hindu Code Bill. Dr. Sarkar deprecates such legislation as divorce laws in the absence of factual and statistical studies of genetic and sociological problems. A national commission on marriage, he says, should precede the Hindu Code Bill.

Even the much maligned caste system with its group endogamy and clan exogamy has been productive of beneficial results in India, says Dr. Sarkar. Of the sixteen Bengalis who were Presidents of the Indian National Congress, nine have been Kayasthas who are cited as an example of the Galton-Pearson ideal of national eugenics—a dominant fertility of the fitter stocks. Social legislation, says Dr. Sarkar, should be broad-based on this biological axiom.

C. J. JAYADEV.

ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS

IN view of the ever-increasing use of physical methods in problems of biochemistry—especially in borderline fields, Academic Press announces the intended widening of the scope of its journal, *Archives of Biochemistry*. In addition to established biochemical topics, the Editors will consider manuscripts in the fields of virus research, radiation effects on living matter, macromolecular biology and chemistry, studies of the application of radioactive indicators, and physics of biological systems.

Beginning with Volume XXXI, Number 1, March 1951, the title of *Archives of Biochemistry* will be changed to *Archives of Biochemistry and Biophysics* to indicate more accurately the new scope of the journal. The Editorial Board has also been enlarged; Drs. E. Newton Harvey, E. C. Pollard, and R. W. G. Wyckoff have accepted an invitation to serve.

PAPYROGRAPHIC STUDIES ON THE DEGRADATION PRODUCTS OF NUCLEIC ACIDS

B. BHEEMESWAR AND M. SREENIVASAYA

(Section of Fermentation Technology, Indian Institute of Science, Bangalore)

NUCLEIC acid metabolism has engaged our close attention since 1948 because of their intimate association with (*a*) protein synthesis in yeasts; (*b*) glandular secretions in the silkworm and (*c*) viral proliferations in spiked sandal, subjects in which this laboratory has been interested for some time. We have found periodic fluctuations in basophilic stainability of the contents of the yeast cell, running parallel to the mitotic phases.[1a,b] The basophily has been found to be related to the ribonucleic acid content of the cell; similar observations have recently been made by us[2] with respect to the progressive increase in the ribonucleic acid content of the silk gland as it develops to maturity.[3] In viral proliferations, the first reaction of the host to virus infection, results in an increase in the perinuclear basophilia together with a striking increase in cell size. The virus thus induces a ribonucleic acid synthesis in the infected cells immediately followed by growth and protein synthesis.

In a search for micro-analytical methods for a determination of the nucleic acid constituents, we have explored the possibility of applying the papyrographic method[3,4] pursued in these laboratories. Papyrographic separations possess the further advantage of securing for quantitation constituents of spectro-photometric standards of integrity and purity, which enable us to identify and estimate them with considerable ease, accuracy and elegance.

The application of paper chromatography (papyrography) to problems of nucleic acid chemistry was first reported by Vischer and Chargaff,[5] who extended this technique to a quantitative analysis of purines and purimidines of nucleic acids. The procedure consists in locating the constituents of one-dimensional papyrograms (50 × 2 cm.), developed with solvent mixtures (see Table I), by treating the papyrograms with mercury salts on guide strips and converting this salt to the black sulphide of mercury. These black spots serve as a guide for elution of purines and pyrimidines from the corresponding areas of the untreated papyrogram. The papyrographic procedure described by Hotchkiss for the location and quantitation of the constituent,[6] entails the elution of purines, pyrimidines and nucleosides from successive areas of the papyrogram developed with butanol and a determination of the ultra-

TABLE I

Solvent systems	Constituents separated	Author and Reference
3 : 1 Quinoline collidine ..	Adenine and Guanine	Vischer and Chargaff[5]
n-Butanol (neutral) ..	Adenine, Guanine	
n-Butanol morpholine ..	Hypoxanthine, Xanthine	
do *plus* diethylene glycol Collidine	Uracil, Cytosine, Thymine, and corresponding nucleosides	
Butanol-diethylene glycol do *plus* HCl ..	(Nucleotides do not move in any of	Vischer, *et al.* [10]
Butanol—HCl	these solvents)	
isobutyric acid—Amm. isobutyrate pH 3·6 ..	Adenylic acid cytodylic acid and Uridylic acid *plus* Guanylic acid	Vischer, *et al.* [9]
n-Butanol—NH_3 ..	Cytosine, Urasil, Adenine, Thymine, Cytidine, Guanosine and Thymidine	Hotchkiss [6]
Butanol—10% Urea ..	Adenine, Guanine, Uracil, Cytosine, Thymine and corresponding nucleosides	Carter [7]
5% Am. citrate pH 3·6 *Iso* amyl alcohol ..	Separates nucleotides	do
do pH 9·6		
Pot. Dihydrogen phosphate—*Iso* amyl alcohol ..	,,	
Disod. Hydrogen Phosphate—*Iso* amyl alcohol ..	,,	
Pot. dihydrogen Phosphate—*Iso* amyl alcohol ..	,,	
Ter. butanol—HCl—H_2O ..	Adenine and guanine and pyrimidine nucleotides	Markham and Smith [8]

violet absorption of the eluates from these areas. Carter[7] has evolved a technique for resolving mixtures of purines, pyrimidines, nucleosides and nucleotides of yeast nucleic acid with solvents indicated in Table I. A special feature of his papyrographic technique, involves the employment of a two-layered solvent system where the filter-paper is introduced so as to pass through both the phases. He locates these compounds on the papyrograms by ultra-violet fluorescence, thus eliminating the necessity of having guide strips. Markham and Smith[8] have developed a photographic technique based on the characteristic absorption of these compounds in the ultra-violet (253·7 and 265 $m\mu$).

A careful study of Table I reveal that among the immiscible alcohols, butyl and *iso*-amyl have been used. Miscible alcohols have not so far, been used as developing solvents for papyrographic separations. N-propanol —0·5 N HCl has, however, been used for the separation of the constituents on a starch column. In our present study, an attempt has been made to compare the relative merits of several solvent mixtures.

Experimental

Inverted bell jars (14 cm. × 26 cm.) with ground edges securely covered with ground glass discs with vaseline, were used as developing vessels. The solvent mixture (30 ml.) was placed at the bottom in a separate (8 cm.) petri-dish. Filter-paper (Whatman No. 1) (10 cm. × 20 cm.) carried 5 spots. Four of them consist of 0·01 ml. of a 1% solution of adenine sulphate (GBI), guanine (BDH), uracil (GBI) and xanthine (GBI), prepared according to the methods given by Gyorgi.[11] The fifth spot represented a mixture of the above constituents.

The solvent systems employed are: (1) 2 : 1 ethanol 0·5 N HCl; (2) ethanol in ammonia atmosphere; (3) 2 : 1 propanol — 0·5 N HCl; (4) propanol in ammonia atmosphere; (5) butanol—5 per cent. aqueous urea; (6) butanol in ammonia atmosphere; (7) *iso*-amyl alcohol—ammonium citrate (two-layer system); (8) *Iso*-butyric acid-ammonium isobutyrate at pH 3·6-3·7. The spotted filter-paper placed in the vessel attained equilibrium with the vapour-phase of the solvent mixture; filter-papers were then lowered into the petri-dish containing the developing solvent. The time taken for developing the papyrogram usually takes about 4 hours, at the room temperature (24 to 25° C.). The filter-paper was then air dried and printed photographically over Ilford document paper No. 50, employing the ultra-violet radiation as recommended by Markham, *et al.*, with slight modifications. The position of the constituents were located on the print as white spots against a black background. The R_F values were determined in the usual way. The R_F values obtained by us are given in Table II along with the values repored by others in brackets.

Table II

No.	Solvent system employed	Adenine	Guanine	Uracil	Xanthine
1	2 : 1 Ethanol—HCl	0·59	0·44	0·75	0·0
2	Ethanol—NH_3	0·65	0·54	0·72	0·61
3	Propanol—HCl	0·46	0·30	0·66	0·0
4	Propanol—NH_3	0·67	0·45	0·69	0·52
5	Butanol—5 Urea	0·08 (0·41)	0·12 (0·05)	0·34 (0·35)	0·0 (0·12)
6	Butanol—Ammonia	0·41	0·1	0·27	0·16
7	*Iso* amyl—Am. citrate	0·63 (0·69)	0·0 (0·50)	0·81 (0·72)	0·0 (0·52)
8	*Iso* butyric acid—Am. *Iso* butyrate pH 3 6	0·93	0·70	0·70	0·55

Discussion

From Table II it can be seen that, of all the solvent systems employed, ethyl alcohol-0·5N-HCl 2 : 1 is advantageous over others since, better and more discrete separations of the 3 constituents out of the 4 contained in the mixture, have been secured (see Fig. 1). Further, ethanol is readily available and is less expensive. Equally good separations are obtained with mixtures of *n*-propanol-HCl (2 : 1). Among other solvent systems studied, the R_F values of a pair of the four constituents employed as a mixture overlap each other, resulting in inefficient separations. If the solvent system is too acidic, xanthine (alkaline soluble) gives a streak. If the solvent system is made alkaline by creating an atmosphere of ammonia, the acid-soluble guanine streaks. Isobutyric acids—ammonium isobutyrate at pH 3·6 to 3·7, is the recommended solvent[9] for separating nucleotides. We have used this solvent mixture for separating the bases, because, it is necessary to determine the positions occupied by the various constituents when a mixture of nucleotides and bases are encountered.

Our studies are confined only to the three bases, ordinarily occurring in nucleic acids. Xanthine, however, has been included. Cytosine, thymine and the related nucleosides and nucleotides have not been readily available for our work. We have, however, attempted a separation of a nucleotide mixture obtained from a baryta hydrolysate[12] of yeast nucleic

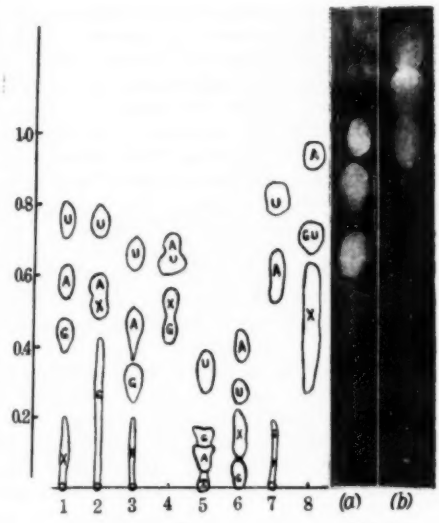


FIG. 1

A—Adenine
G—Guanine
U—Uracil
X—Xanthine

FIG. 2

(*a*) Isobutyric-Am. butyrate. Three spots in the descending order are adenylic, cytidylic and(guanylic & uridylic.
(*b*) Devoloped in Ethanol–Hcl.

acid (BDH). Papyrograms developed with solvent mixtures of ethanol and isobutyric acid are reproduced (Fig. 2). While we are unable to characterise the different constituents on the papyrogram without the reference spots, the results, however, suggest the possibility of securing better separations of the nucleotides on longer strips with suitably buffered ethanol mixtures. Work in this direction is now in progress.

Our thanks are due to Prof. M. S. Thacker, the Director, for his kind and continued interest, and to the Council of Scientific and Industrial Research for their generous financial aid.

1. (*a*) Bheemeswar and Somakumar, *J. Sci. and Ind. Res.*, 1948, **7 B**, 131. 1. (*b*) Bheemeswar, B. and Sreenivasaya, M., 1948, Unpublished results. 2. Sreenivasaya, M. and Ramachandra Rao, T. N., 1950, Unpublished results. 3 Govindarajan, V. S. and Sreenivasaya, M., *Curr. Sci.*, 1950, **19**, 239. 4. —, *Ibid.*, 1950, **19**, 39. 5. Vischer, E., and Chargaff, E., *J. Biol. Chem.* 1947, **168**, 781. 6. Hotchkiss, R. D., *Ibid.*, 1948, **175**, 315. 7. Carter, C. E., *J. Am. Chem. Soc.*, 1950, **72**, 1466. 8. Markham, R. and Smith, J. D., *Biochem. J.*, 1949, **46**, 509. 9. Magasanik, *et al.*, *J. Biol. Chem.*, 1950, **185**, 37. 10. Vischer, E. and Chargaff, E., *Ibid.*, 1948, **176**, 704. 11. Gyorgi, P., *Vitamin Methods*, Acad. Press, N. Y., 1950, **1**, 365. 12. Loring, H. E., Roll, P. M. and Pierce, J. C., *J. Biol. Chem.*, 1948, **174**, 729.

SOIL CONSERVATION—A VITAL NEED OF THE NATION*

A SAMPLE survey conducted in 1950 in certain parts of Bombay reveals that 71 per cent. of the land has been denuded partially or totally, of which 32 per cent. is wholly unfit for crops. The danger is on the increase and it is imperative that immediate steps be taken to conserve our soil.

The three guiding factors for conservative farming on level land are: (1) building up of soil structure; (2) improvement in soil permeability; and (3) provision of crop cover during the period of heavy showers.

Measures for mechanical means of erosion control involve a careful study of soil profiles, soil permeability and run-off and field trials to determine, suitable types of terraces for different soil zones, terrace spacing, types of waste weirs, etc.

In areas of low and uncertain rainfall, the major problems associated with dry farming are: (1) selection of crops; (2) moisture conservation; (3) improving soil texture by rotations, tillage and fallows; and (4) supplying deficiencies of plant food by manuring. The needs of the soil under each of these should be carefully worked out for each zone.

The most common features of deterioration in irrigated soils are water-logging, salinity, loss of soil structure and fertility constituents and adverse microbiological conditions. Well planned soil studies based on a correct classification of the soils and a thorough understanding of their nature are an essential prerequisite for the conservation of the soil fertility over a long period by proper adjustment of water, manure and crop rotations. The genetic method of soil classification based on the entire soil profile as the unit of study and other associated experiments, that are being followed, in Bombay, is worth a detailed study in this connection.

Among unproductive soils, the saline soils deserve a special and detailed study, as the potentialities of obtaining good crops after these soils have been properly reclaimed have been amply demonstrated. These may be naturally occurring saline soils in dry areas or soils rendered saline by irrigation. In the Bombay State successful reclamation methods have been worked out both under irrigation and dry cultivation and proper crop husbandry recommended for right land utilisation.

B. DASAPPA.

* Abstract of Presidential Address, by Dr. J. K. Basu, Ph.D., F.N.I., to the Section of Agricultural Sciences, during the 38th Session of the Indian Science Congress, 1951.

THE ROLE OF SALIENTIA IN HUMAN AND MAMMALIAN PREGNANCY TESTS*

IN an exceedingly fascinating address, Dr. Bhaduri described the utilization of frogs and toads as test animals in the determination of early human and mammalian pregnancies. Since clinical tests alone are not satisfactory in early pregnancy diagnosis, it could be made more accurate if supplemented with laboratory biological determinations. Aschheim-Zondek test was the earliest to be proposed and a modification of this by Freedman utilizing isolated virgin female rabbits was in vogue till recently when the female *Xenopus* test became another tool in the hands of gynecologists.

It was Galli Mainini who initiated the use of male toads as test animals and since then, a large amount of literature has grown on the use of this animal for diagnosing early pregnancy. According to Dr. Bhaduri, the technique consists in injecting 1 to 10 c.c. of urine from a woman suspected of pregnancy into the dorsolateral lymph space of a male toad (*Bufo*) whose urine has been previously declared by microscopic examination to be sperm-free. After a lapse of half an hour, the urine of the toad, either taken out by a catheter or made to void by gentle coaxing, is examined microscopically. The presence of sperms, dead or alive, motile or otherwise would indicate a positive reaction. A confirmation of this may be made again. Should the result be negative, the injection may be repeated a second time and the urine examined. The gonadotropic harmone present in the pregnant human (or mammalian urine) causes the sperms to be produced in the frogs and toads.

The author has used toxic urine with definite results and he has also pointed out that side by side using urine, serum has been tried by various workers but the former has certain advantages.

It is interesting to note that in pathological cases, the author points out that both positive and negative reactions result; in a case which yielded a negative result, it was discovered that the patient aborted three days later. Therefore, it would be worthwhile for the physician to correlate his clinical data with this simple biological test.

Fæces of pregnant females and of farm animals have also been successfully used. It is hoped that the frogs and toads which are already martyrs to biological sciences may become more so in view of the recent discoveries in endocrinology.

L. S. R.

* Abstract of Presidential Address, by Prof. J. L. Bhaduri to the Zoology Section of the Indian Science Congress, 1951.

PLANNING FOR PROSPERITY

IN his Presidential Address to the Engineering and Metallurgy Section, Indian Science Congress, 1951 Session, Prof. M. S. Thacker observed that the execution of the power projects and the starting of industries will necessitate the provision of technically trained personnel in large numbers. A beginning to meet this demand has already been made in the establishment of four National Laboratories in the proposed chain of eleven ones, and starting of higher technological institutes under the dynamic leadership of the Prime Minister and the able guidance of Sir Shanti Swaroop Bhatnagar. During the initial stages, close collaboration with foreign technical experts will be necessary, but it is important that initiative in all schemes should invariably be in the hands of the local personnel. Designs of these projects should be such as to make maximum use of local labour and materials.

Institutions like the Indian Institute of Science where such work is already being done should be encouraged by giving further large grants. Research in Power Engineering, Hydraulic Machines Design, etc., are essential if the multi-purpose projects are to succeed. There should be perfect co-ordination of activities between research and the field executive.

Planning for power and irrigation on such a large scale, presupposes an overall plan to integrate with these other activities to ensure a well-balanced programme of development. The constitution of a National Planning Commission is a step in the right direction. As the chain of projects is under way, it is essential to carry out periodical surveys to obtain an overall picture of progress achieved and to be achieved.

The basic ideas which make possible industrial advancement come out of scientific discovery or creative activity. If the contributions of research were to be reduced, the industries would tend to freeze into a particular pattern and ere long become moulded.

It is up to the scientists and enginers of present-day India, to show to the world that they can, by their efforts, build up a new India, which the other countries of the world will look up to.

N. S. G.

LETTERS TO THE EDITOR

PAGE

Near U. V. Absorption of Para-*Chloro-Phenol*—C. RAMASASTRY 65

On Thickness Lines in Relation to the Onset and Movement of Cold Waves in Western Pakistan and Northern and Central India During Winter—C. RAMASWAMY .. 65

Chromatographic Separation of Vat Dyes—N. R. RAO, K. H. SHAH AND K. VENKATARAMAN 66

Colouration of Hydrogenated Fats with Chlorophyll to Prevent Adulteration of Ghee—S. V. PUNTAMBEKAR AND P. RAMACHANDRA RAO 68

Rot of Mangifera indica *Linn. Caused by* Aspergillus—G. S. VERMA AND M. KAMAL 68

Hormone Induced Parthenocarpy in Hibiscus esculentum *and* Solanum melongena —SHRI RANJAN AND MISS RAVINDER KAUR 69

PAGE

Chromosome Number and Morphology in Physalis—N. P. SINHA 70

A Double-Blade Method for Making Good Sections—B. S. NAVALKAR 71

Cytological Studies in Ottelia—Y. SUNDAR RAO 72

A Mutant in Asiatic Cotton—R. BALASUBRAHMANYAN 73

The Endosperm in Crotalaria—M. ANANTASWAMY RAU 73

A Preliminary Note on Rickettsiosis in Sheep and Goats in Bombay State—S. L. MANJREKAR 74

On the Biological Oxidation of Sewage—S. C. PILLAI 75

NEAR U. V. ABSORPTION OF *PARA*-CHLORO-PHENOL

IN the region 2920A-2680A, about thirty absorption bands have been recorded due to the disubstituted benzene molecule, *para*-chlorophenol in its vapour state. The region of absorption is in general agreement with that observed by Purvis and McCleland.[1] Assuming the electronic transition to be an allowed one, the vibrational analysis of the bands could be carried out with the O—O band located at 2871·0, 34820 and in terms of eight upper state vibrational frequencies; 135, 170, 346, 795, 960, 1053, 1212 and 1450 cm.$^{-1}$

Comparison of these with the upper state vibrational energies of ortho-chloro-phenol,[2] and also with those of phenol,[3] hydroquinone, resorcinol, catechol,[4] *ortho*-, *meta*-, *para*-cresols,[5] indicated that the frequency of about 800 cm.$^{-1}$, found in these spectra, has to be associated with the C—OH vibration as was first remarked by Sreeramamurty.[5] In *para*-chlorophenol, the band representing the 795 cm.$^{-1}$ vibration is the strongest (next to O—O) while in the case of *ortho*-chloro-phenol the 953 cm.$^{-1}$ carbon vibration is very strong.

Bands occurring displaced to the red side of the O—O by approximately 176 cm.$^{-1}$ and 407 cm.$^{-1}$ probably represent vibrations in the lower state. A difference frequency of about 25 cm.$^{-1}$ was also detected.

Full details of the work will be published in the *Proceedings of the National Institute of Sciences of India*. The author is indebted to Prof. K. R. Rao for his interest in the work.

Andhra University, C. RAMASASTRY.
Waltair,
December 27, 1950.

1. Purvis and McCleland, *J. Chem. Soc.*, **1913**, **103**, 1088. 2. Ramasastry, *Proc. Nat. Inst. Sci. India*, 1950, in press. 3. Matsen, F. A., *et al.*, *J. Chem. Phys.*, 1945, **13**, 309. 4. Carl A. Beck, *Ibid.*, 1950, **18**, 1135. 5. Sreeramamurty, *Proc. Phy. Soc. London*, 1950, Communicated.

ON THICKNESS LINES IN RELATION TO THE ONSET AND MOVEMENT OF COLD WAVES IN WESTERN PAKISTAN AND NORTHERN AND CENTRAL INDIA DURING WINTER

PETTERSSEN[1] has shown from theoretical considerations that southerly thermal winds in advance of a sea-level anticyclone or wedge of

high pressure will cause an acceleration in the eastward movement of the high pressure system. This conclusion is based on the assumption that (1) the transport term in the height (pressure) tendency equation can be neglected and (2) the divergence term in the tendency equation is mainly due to the geostrophic thermal wind contribution. In order to test the usefulness of this rule in day-to-day forecasting, the present writer has made a detailed study of two well-marked high pressure systems which rapidly moved across Western Pakistan and Northern and Central India during the following two periods: (1) 8th to 11th February, 1950; (2) 9th to 11th February, 1951.

In the above spells, (*a*) in advance of the 12 GMT sea-level seasonal high on each of the days, the thickness lines on the 1500 GMT 700 mb. chart (drawn on the basis of the radiosonde data over India and the neighbouring countries and the thermal winds computed from the vector wind shear between the 1000 and 700 mb. levels) ran from south-southwest to north-northeast; (*b*) during the 24 hours subsequent to the 12 GMT chart on each of the days, there was a rapid eastward movement of a wedge of high pressure and of the 24 hours positive isallobars across Western Pakistan and Northen and Central India; (*c*) the rapid movement of the wedge of high pressure caused a progressive eastward surge of extra-tropical continental air into Western Pakistan and Northern and Central India and a marked cold spell in these regions. In the spell of 8th-11th February, 1950, sudden and very large drops in minimum temperature amounting to as much as 20°-30° F. occurred in 24 hours in Rajasthan, Madhya Bharat and north Madhya Pradesh.

It is interesting to note that (*a*) the horizontal pressure gradient at sea-level in the region of the thermal winds in both the above cases, was generally weak and, therefore, the transport term in the tendency equation could be neglected, at least as a first approximation; (*b*) the region studied lay between 21° N. and 35° N. The isobaric-mean wind between 1000 and 700 mb. in this region did not also exceed 30-40 knots[2] almost on all the days. It would therefore be justifiable to assume that the thermal wind represented the major portion[3] of the vector wind shear between 1000 and 700 mb. It may also be pointed out that the well-known mean meridional cross-sections prepared by Hess[4] and reproduced by Rossby[5] are based on the assumption that the geostrophic wind equations can be considered to be valid upto about *12° N.* R. A. S. Ratcliffe[6] has also very recently reported that thermal winds computed from the vertical wind shear (as has been done by the present writer) shows reasonable agreement with geostrophic values even at latitude 10° N. in the Indian area; (*c*) the periods studied were during winter when the pressure systems which affect Western Pakistan and Northern and Central India resemble those of middle latitudes.

It is realised that no broad generalisation can be made on the study of these two cold spells only. Nevertheless, the fact that the conclusions drawn from Petterssen's rule agree very well with the *observed facts* in these two typical cases, would seem to suggest that the run of the thickness lines in relation to the position of the sea-level high can be used as an additional factor in forecasting the rapid onset and movement of cold waves across Western Pakistan and Northern and Central India in winter.

Fuller details of this investigation together with the daily sea-level charts and thickness patterns during these spells, will be published elsewhere.

Meteorological Office, Poona 5. C. RAMASWAMY.

February 23, 1951.

1. Petterssen, *Quart. Jour. of Royal Met. Soc.*, **1945**, **71**, 56–73. 2. —, *Synoptic Divisions Technical Memorandum* No. 78 Meteorological Office, Air Ministry, 1944, 8. 3. Joseph Vederman, *Bull. Amer. Met. Soc.*, November 1946, **27**, 532–36. 4. Seymour, L. Hess, *Jour. Met.*, Dec. 1948, **5**, No. 6, 293–300. 5. Rossby, C. G., *Atmospheres of the Earth and Planets*, University of Chicago Press, 1949, 16–48. 6. R. A. S. Ratcliffe, *Upper Air Analysis and Tropical Forecasting*, London Meteorological Office, *Meteorological Reports*, **1950**, No. 8.

CHROMATOGRAPHIC SEPARATION OF VAT DYES

IN a previous communication methods for the chromatographic separation of water-soluble dyes of the acid, basic and direct cotton classes were outlined,[1] and procedures for the separation of vat dyes have now been developed. A generally applicable method is to vat the mixture of dyes with aqueous tetraethylenepentamine, $NH_2(CH_2CH_2NH)_3CH_2CH_2NH_2$, and sodium hydrosulphite, carry out the aqueous tetraethylenepentamine containing a (80 mesh), and develop the chromatogram with aqueous tetraethylenepentamine containing a little hydrosulphite. One part of the organic solvent and four parts of water are employed

both for adsorption and development. A clear and remarkably stable vat is obtained when a vat dye is made into a paste with tetraethylenepentamine and treated with aqueous hydrosulphite solution at room temperature (23-30°). Employing these conditions, the following mixtures have been separated; the dyes in each mixture are mentioned in the order of increasing adsorbability, the last dye being at the top of the column: (1) Caledon Gold Orange G and dibenzanthrone; (2) Caledon Yellow 3G and Caledon Brilliant Purple 4R; (3) Caledon Yellow 3G, Caledon Jade Green, Caledon Red BNS and dibenzanthrone. Diethylenetriamine and triethylenetetramine are less satisfactory than tetraethylenepentamine; morpholine and ethylenediamine have more limited scope, and can only be used for the separation of pairs of dyes which differ widely in their substantivity to cellulose (*e.g.*, Caledon Yellow 3G and Caledon Brilliant Purple 4R). *n*-Butylamine, which has been recommended as an effective solvent in conjunction with hydrosulphite for stripping vat dyes,[2] gives a clear vat in the absence of caustic soda, but *n*-butylamine is less effective than tetraethylenepentamine in separating a mixture of vat dyes by chromatography on a cellulose column.

Brown[3] has described a method of adsorption separation on paper which he used for separating green leaf pigments from a carbon disulphide solution. A sheet of paper is placed between two glass plates (*e.g.*, 6 inches square). The cover plate has a small hole (3/16 or 1/4") at the centre. A solution of the mixture is added dropwise through the hole, followed by the solvent; the components travel outwards in concentric zones, and clear separation of certain mixtures can be effected in this manner. Brown's technique can be applied to vat dyes by using aqueous tetraethylenepentamine and hydrosulphite, both for vatting and development. The only disadvantage of the filter-paper and glass plate technique is that an outer yellow band of tetraethylenepentamine appears when the filter-paper is dried.

The procedure we have described for the separation of direct dyes on cellulose acetate, nylon or vinyon[1] can be modified for application to vat dyes. A suitable fabric is Lumite, which is woven from Saran of filament diameter 0·008" and mesh construction 120 × 56. The fabric is activated by immersing in dioxane at 50° for one hour, rinsing with saturated sodium chloride solution, and drying; the fabric shrinks and the natural yellow colour is bleached. When a few drops of a solution of a mixture of vat dyes (*e.g.*, Caledon Red X5B and Caledon Jade Green) in concentrated sulphuric acid are placed on the fabric, followed by a few drops of the acid, separation takes place.

It has been claimed that vat dyes in nitrobenzene solution can be separated on alumina,[4] but most vat dyes are insoluble or very sparingly soluble in nitrobenzene (and other organic solvents) in the cold. Conflicting statements on the separability of alkaline vats on alumina have been made.[4,5,6] Vat dyes reduced by aqueous caustic soda and hydrosulphite have been chromatographed on columns of bleached sawdust or disintegrated cotton; the chromatogram was then developed in the colours of the oxidized dyes by means of potassium ferricyanide solution.[4] The rate of flow through paper pulp was found to be too slow.[4] In our experience it is only a mixture of dyes of widely different substantivity to cellulose (*e.g.*, α-benzamidoanthraquinone and dibenzanthrone) that can be separated by this method. A mixture of dyes such as Caledon Jade Green and dibenzanthrone does not undergo clear separation from an aqueous caustic soda—hydrosulphite solution on filter-paper. Even in the former case we have observed that the addition of ethanol or pyridine is useful, since it stabilizes the vat and cuts down the substantivity. By the addition of an equal volume of pyridine to the aqueous caustic soda-hydrosulphite vat and by using a 1 : 1 mixture of water and pyridine containing caustic soda and hydrosulphite for development, the following mixtures have been separated on filter-paper by the glass plate technique; the dyes are mentioned in the order of increasing adsorbability; (1) Caledon Jade Green and dibenzanthrone; (2) Caledon Yellow 3G and dibenzanthrone; (3) Caledon Gold Orange G and Caledon Brilliant Purple 4R. A slight modification by adsorbing from aqueous alkaline hydrosulphite solution and developing with a 1 : 1 mixture of water and pyridine containing caustic soda and hydrosulphite is useful for the separation of certain mixtures (*e.g.*, Caledon Red BN and Caledon Gold Orange G).

We are indebted to the Council of Scientific and Industrial Research for the award of a Fellowship to one of us, to Dr. R. V. Bhat of the Forest Research Institute, Dehra Dun, for preparing cellulose powder, and to the Dow Chemical Co. and Chicopee Manufacturing

Corporation of U.S.A. for the supply of Lumite.

Dept. of Chem. Tech., N. R. RAO.
Univ. of Bombay, K. H. SHAH.
Bombay 19, K. VENKATARAMAN.
February 7, 1951.

1. Rao, Shah and Venkataraman, *Curr. Sci.*, 1950, **19**, 149. 2. Mathewson, *Am. Dyestuffs Reptr.*, 1948, **37**, 709; and earlier references cited in this paper. 3. Brown, *Nature*, 1939, **143**, 377. 4. Johnson, quoted by Vickerstaff, *The Physical Chemistry of Dyeing*, p. 27. Oliver and Boyd, London, 1950. 5. Fox, *Vat Dyestuffs and Vat Dyeing*, Chapman and Hall, London, 1946. 6. Bilik, *Novosti Tekhniki*, 1936, No. 42-3, 42.

COLOURATION OF HYDROGENATED FATS WITH CHLOROPHYLL TO PREVENT ADULTERATION OF GHEE

WITH a view to preventing adulteration of ghee with hydrogenated fats, the colouration of the latter with a number of organic colouring matters has been tried, but none of them has been considered to be suitable for one reason or other. It has now been found that chlorophyll can be satisfactorily used for colouring hydrogenated fats so as to prevent their use as adulterants of ghee. In actual practice, it is not necessary to use the chemically pure pigment, the total chlorophyll extract serving the purpose amply well. It is found that the use of 1 lb. of the pigment for every 1,000 lbs. of fat imparts a pleasant yellowish-green colour giving 30 yellow and 4 blue in a Lovibond Tintometer in a ½ cm. cell.

Chlorophyll is available in any quantity and is perfectly edible. Besides not being harmful it is stated to act as an oxidation catalyst in the metabolic processes of the human body, being the "life-giving substance (which) is probably the answer to the prayer for prolonging the useful span of life."[1] It has the further advantage of being easily detected by the red fluorescence of the melted fat in sunlight or more prominently in the ultraviolet light. A suitable source for the extraction of the pigment is the leaves of the common vegetable plant *Spinacia oleracea* Linn. (Spinach or Palak) which gives 5 per cent. of the crude pigment from the dry leaves (8 per cent. moisture). Other convenient sources are the leaves of the forest plants, *Urtica parviflora* Roxb. (Indian Stinging Nettle) and *Clerodendron infortunatum* Gaertn. which give 3·5 per cent. of the pigment. From these materials the pigment is easily extractable by the method of Willstatter and Stoll[2] using 80 per cent. acetone or 90 per cent. alcohol.

A sample of the fat coloured with chlorophyll cannot be used for adulteration, since its presence in ghee in as low a quantity as 10 per cent. can be easily detected by the marked greenish tinge. Any attempt to decolourise the "chlorophyllised fat" by heat or exposure to sunlight with a view to using it as an adulterant will not be successful, since the sample does not get completely decolourised but becomes only discoloured and exhibits a marked deep red fluorescence in ultraviolet light or even sunlight. Also such samples very readily respond to a microchemical test[3] for magnesium which is present in the chlorophyll molecule. By this test it is possible to detect chlorophyllised vanaspati even to the extent of 1 per cent. in pure ghee. Although chlorophyll, like any other pigment, is almost completely removed by treatment with animal charcoal or Fuller's earth, yet even the little that remains in the fat clearly responds to the fluorescence test. Further such treatment is too difficult and costly to be practised profitably on a large scale.

Forest Res. Inst., S. V. PUNTAMBEKAR.
Dehra Dun, P. RAMACHANDRA RAO.
December 26, 1950.

1. Berkmann, S. and Berkmann, B., *Chemurgic Digest*, 1948, **7** (4,). 8; *Economic Botany*, 1948, **2**, 362. 2. Willstatter, R. and Stoll, A., *Untersuchungen uber chlorophyll*, Berlin, 1913. 3. Kolthoff, I. M., *Chem. Weekblad*, 1927, **24**, 254; *Biochem. Zeitung*, 1927, **185**, 334; *Analyst*, 1927, **52**, 430.

ROT OF *MANGIFERA INDICA* LINN. CAUSED BY *ASPERGILLUS*

OUR attention was drawn towards lesions on mangoes observed year after year in several orchards in Lucknow and other districts. About 25 per cent. of the crop of the varieties, *Dasehri*, *Amin*, *Mohanbhog*, *Tukhmi*, *Khajli*, *Gola* and *Safeda*, are usually affected; the last two are particularly susceptible.

The first external symptom is a yellowing of the region. Then some irregular, hazy, greyish spots appear which coalesce to form a dark-brown or black spot, 1–1½ cm. in diameter. Usually the basal part of the fruit is affected but cases have been observed where other regions have been involved. Rarely it may be lateral but it has never been found at the tip (Fig. 1). In advanced cases the lesion shows a depression and softening of the meso-

carp while the remaining portion is quite hard. When the disease occurs at the stalk end, there is a premature falling of the fruits.

FIG. 1. [A Diseased Fruit of the Safeda variety

A transverse section of the diseased portion showed that the epicarp, mesocarp and the endocarp were affected. Besides softening into a pulpy mass the mesocarp assumed a brown colour and showed the presence of hyphæ and spores under the microscope. Hyphæ are present in the cells of the stalk upto approximately 4" from the point of attachment.

Isolations were made from the infected tissues under sterile conditions and almost invariably, uncontaminated growth of *Aspergillus*, identified as *A. niger*, was observed. Fruits of different varieties on trees were inoculated after the method devised by M. Kay[1] by putting the inoculum on the injured surface and covering it with sterile paraffin wax. It was found possible to reproduce the normal lesions. A fungus morphologically alike was reisolated from the experimental fruits.

It remains to be seen how the fungus enters the fruit. Most likely it enters through a wound caused by the crawling of insects or by pecking of birds from where the hyphæ traverse into the stalk region.

Das Gupta and Bhatt[2] have reported latent infection of mangoes by *Aspergillus* spp. including *A. niger* causing rots during storage. As far as known to the authors this is the first record of the disease in Nature.

Botany Department, G. S. VERMA.
University of Lucknow, M. KAMAL.
August 25, 1950.

1. *Sci. Proc. Roy. Dubl. Soc.*, **1926**, **18**, 14, 169–84.
2. *J. I. B. S.*, **1946**, **25**, 4, 187–203.

HORMONE INDUCED PARTHENOCARPY IN *HIBISCUS ESCULENTUM* AND *SOLANUM MELONGENA*

Two techniques for the application of hormones have been followed, *viz.*, (*a*) spraying, and (*b*) hormone paste.

Hibiscus esculentum.—The fruits under study were at the pre-anthesis, anthesis, and post-anthesis stages. The selected flowers were emasculated and the stigma removed. In those cases which were sprayed with 0·01% methyl naphthoxy acetate, 4 times at intervals of 24 hours, the fruits dropped off soon after setting. Therefore, in the subsequent experiments the flowers were sprayed only once.

The experimental findings are given below:

Pre-anthesis.—Sprayings with 0·5% Indole butyric acid, 0·01% methyl naphthoxy acetate and 0·1% chlorophenoxy acetic acid showed entirely seedless development of the fruit. The fruits attained almost the normal size. In the case of Indole butyric acid, however, the fruits were less fibrous and remained green for a long time [Fig. 1 (B)].

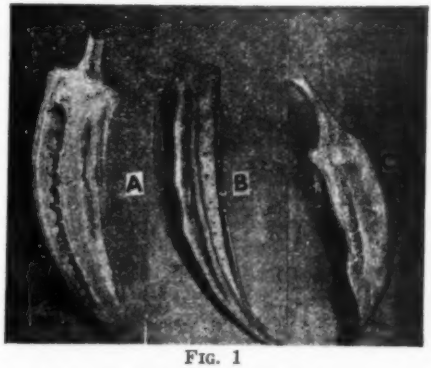


FIG. 1

Application of hormones at Pre-anthesis stage.
(A) 0·25% 2 4 dichlorophenoxy acetic acid applied as paste.
(B) 0·5% Indole butyric acid applied as spray.
(C) 0·25% Indole butyric acid plus B-naphthoxy acetic acid applied as paste.

The hormone paste was applied on the cut end of the style with a dissecting needle without smearing it round the ovary wall, which was found to damage the fruit.

The application of α-naphthalene acetic acid as paste in all concentrations, *viz.*, 0·05 to 1% resulted in the dropping-off of the fruit at an early stage. 0·1% of β-naphthoxy acetic acid, 0·05% and 0·1% chlorophenoxy acetic acid,

0·25% 2 : 4-dichlorophenoxy acetic acid and 0·25% Indole butyric acid plus β-naphthoxy acetic acid give satisfactory results, and resulted in the development of the fruits [Figs. 1 (A, C) and 2 (B)]. All these fruits, however, remained slightly smaller than the control.

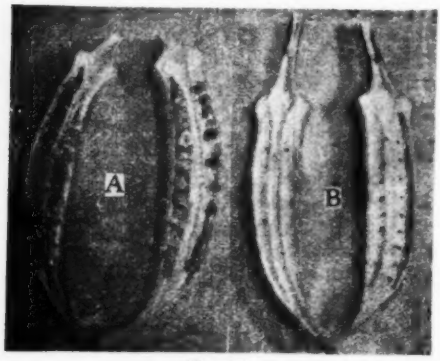


FIG. 2

(A) Control

(B) 0·1% B-naphthoxy acetic acid applied as paste at per anthesis stage.

Anthesis.—The same concentration of hormones was given as earlier. The results show that the fruits developed were of the same size as the control and larger than the fruits treated at the pre-anthesis stage. It was also noticed that some fruits were partly seeded. Some of these seeds were of normal size. It is presumed that in some cases fertilization must have taken place before emasculation, resulting in partial seed formation.

There was one significant point of difference between the anthesis and pre-anthesis stages, *viz.*, whereas in the latter case, α-naphthalene acetic acid in all concentrations had harmful effect, in the former case 0·1% and 0·2% produced the same effect as those with the other chemicals mentioned.

Post-anthesis.—The work on post-anthesis was not connected with the production of seedless fruit but was mainly directed to find out the sizes of the fruit. It was noticed that after the application of 0·1% and 0·2% α-naphthalene acetic acid, 0·05% and 0·1% chlorophenoxy acetic acid and 0·25% 2:4-dichlrophenoxy acetic acid the sizes of the fruits developed to a greater extent than the control.

With regard to the sizes of the fruit, Gustafson[1] (1939) has expressed the view that in the case of tomatoes the difference in size must be due to the smaller cells in the parthenocarpic fruits than in the seeded fruits. Our experiment supports Gustafson's view indirectly. If we assume that cell expansion is brought about by the agency of auxin from pollen as also by the specific chemical hormones applied, then at the post-anthesis stage the fruits will receive a larger dose of the mixed hormones resulting in bigger-sized fruits. At the anthesis stage the fruits were of normal size, this may be due to the cumulative effects of (*a*) hormones applied to the flower, and (*b*) the auxins supplied to a limited extent by fertilization of a limited number of ovules. The smaller-sized fruits, at the pre-anthesis hormone-treated fruits, show that the development of the ovary depended entirely upon the chemical hormones applied. If the quantity of auxin present is responsible for the size, it would seem possible to increase the size of the parthenocarpic fruits by supplying them with more auxin. Methods for doing this will have to be developed as it is not sufficient merely to smear more hormone paste on fruits, which may be injurious.

Solanum melongena.—*In* the case of *S. melongena*, the investigation was carried out only at the pre-anthesis stage, the bud being subjected to the same hormone treatment as in the previous case.

The buds were sprayed with 0·01% and 0·001% methyl naphthoxy acetate. The hormone paste used was 0·2% α-naphthalene acetic acid. The fruits so produced were seedless. Besides, their bases were broader, circular, and tapering sharply towards the apex.

Further work is in progress.

SHRI RANJAN.
MISS RAVINDER KAUR.

Dept. of Botany,
University of Allahabad,
September 16, 1950.

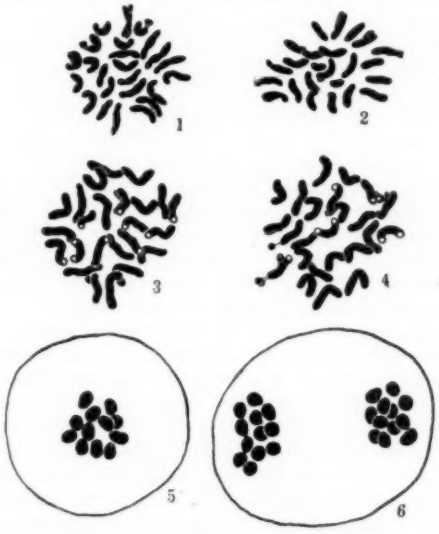
1. Gustafson, F. G., "Parthenocarpic and normal fruits compared as to percentage of setting and size," *Botanical Gazette*, 1940, 280–86. 2. —, "Auxin distribution in fruits and its significance in fruit development," *American Journal of Botany*, 1939, 189-93. 3. —, and Houghtaling, H. B., "Relation between fruit size and food supply in the tomato," *Plant Physiology*, 1939, 321-32. 4. MacArthur, J. W., and Buttler, L., "Size inheritance and geometric processes in the tomato fruit," *Genetics*, 1938, 253-68.

CHROMOSOME NUMBER AND MORPHOLOGY IN *PHYSALIS*

ACCORDING to Darlington and Janaki Ammal,[1] the species of *Physalis* are all diploids with 24 somatic chromosomes excepting *P. minima*

which has $2n = 48$; but counts by different authors differ. For example, in *P. peruviana* and *P. angulata* besides the diploid number, $2n = 48$ has been reported by Vilmorin and Simonet[4] and Yamamoto and Sakai.[5] Later, $2n = 48$ in *P. pubescens* also was reported by Tokunaga.[3] Such differences in chromosome number give indication of polyploid forms existing within some of the species. With this idea the present author undertook a revised cytological study of some of the species. The important observation are described below:

For examination of the somatic chromosomes, root tip sections were obtained from *P. peruviana*, *P. pubescens*, *P. alkekengi* and *P. Francheti* all of which showed $2n = 24$ (Figs. 1 to 4) Counts for the unrecorded species *P. lanceifolia* and *P. ixocarpa* were made from the first and second metaphases of the dividing pollen mother cells (Figs. 5 and 6) which showed the haploid number to be twelve in each case. Thus no sign of polyploidy could be detected.



From the somatic plates, it can be seen that the chromosomes of *P. alkekengi* and *P. Francheti* are different in size and morphology from those of *P. peruviana* and *P. pubescens* which also differ from each other slightly. In the former two species (Figs. 3 and 4), the chromosomes are larger and the spindle-attachment region, except in a few cases, is not clear; but probably it is either median or sub-terminal. In the somatic metaphase plate of *P. alkekengi* represented by Nakajima[2] also, the chromosomes appear to be large and without any apparent constriction. Constrictions in *P. peruviana*, on the other hand, are well-defined and less so in *P. pubescens*. Nearly half the number of chromosomes in *P. peruviana* are secondarily constricted and the rest have either median or sub-median attachment. In *P. pubescens*, however, secondary constriction is clearly observable only in one pair. The remaining chromosomes, of which there is one pair of the smallest size, have either median or sub-median attachment. No satellites were seen in *P. pubescens* and *P. alkekengi* whereas two chromosomes were satellited in each of the other two.

Department of Botany,
King's College, N. P. SINHA.
University of Durham,
Newcastle-on-Tyne,
England,
October, 1949.

1. Darlington, C. D. and Jamaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 254. 2. Nakajima, G., *Jap. J. Genet.*, 1933, **9**, 1. 3. Tokunaga, K., *Ibid.*, 1932-34, **8-9**, 231-38. 4. Vilmroian, R. and Simonet, R., *C. R. Acad. Sci., Paris*, 1927, **184**, 1646-66. 5. Yamamoto, K. and Sakai, K., *Jap. J. Genet.*, 1932-34, **8-9**, 26 33.

A DOUBLE-BLADE METHOD FOR MAKING GOOD SECTIONS

HAND sectioning of succulent materials is generally accomplished by the help of pith, but by this technique the material gets crushed or distorted, and satisfactory sections are difficult to obtain. In the following method, a good section can be got easily without spoiling the shape or wasting much of the material, time and energy:

1. Clean cut pieces of cucurbita fruit, carrot or any other "pith" even a plane surface of a glass slide will serve as a suitable base.
2. With two sharp safety-razor blades held together firmly between the index finger and the thumb, cut firmly and quickly (crosswise or lengthwise as required).
3. A fine section is obtained (by a stroke or two) in the space between the edges of the blades.

The advantages over the usual razor method are: (1) Economy of material, energy and time; (2) Relatively better sections; (3) Sections at the desired spot; (4) Easy handling of the material; (5) Sections can be taken by any person with very little previous practice;

(6) Method especially useful for succulent, submerged, pulpy parts and thin leaves.

This method, after a fair trial in our laboratory, was found to give satisfaction.

Botany Department, B. S. NAVALKAR.
Institute of Science,
Fort, Bombay 1,
November 24, 1950.

CYTOLOGICAL STUDIES IN *OTTELIA*

Ottelia alismoides was reported to exist in diploid, tetraploid and hexaploid chromosome races with a basic number 11 (Sundar Rao, 1950). It was added that the 22 somatic chromosomes of the diploid race show distinct morphological features (Fig. 1). The hexaploid is characterised by regular formation of 33 bivalents in the PMCs (Fig. 2). The regular disjunction and the absence of multivalents during meiosis indicate the allopolyploid nature.

1

2

In certain morphological features, like the shape of the leaves and the size of the pollen grains, the diploids differ from the polyploids. While the diploids have white flowers, those of the hexaploids are either white or pink. Though not always absolute, the hexaploids show gigantism which is particularly manifest when diploids and polyploids occur together in the same pond. Whenever it is so, the diploids are marginal and the polyploids are deep water forms.

Closely related to the bisexual *Ottelia* is the unisexual *Boottia* spp., which showed a remarkable similarity to hexaploid *O. alismoides* in chromosome number and morphology. This fact lends support to Dandy's view (1934) of the amalgamation of this genus in *Ottelia*. During the present investigation, certain hexaploid bisexual forms resembling unisexual *Boottia* spp., were collected. They probably strengthen Dandy's view and serve as connecting links between *Ottelia* and *Boottia*.

Thus it is clear that there are two evolutionary tendencies in the genus: (*i*) a bisexual condition as in *O. alismoides* with diploids tetraploids and hexaploids; (*ii*) a unisexual and probably polygamous (?) condition as in *Boottia* with only hexaploids. The latter probably arose as an off-shoot from the former at a hexaploid level. According to this view, the ancestral forms of *Boottia* might be hermaphrodite diploids and unisexuality is a later stage in evolution.

Polyploidy is responsible for the wide range of geographic distribution of *O. alismoides* in south-east Asia, eastern tropical Australia and north-eastern Africa. A study of the geographic distribution of the polyploid races of *O. alismoides*, particularly in India, revealed that S. India is the region of greatest variation in having diploids, tetraploids and hexaploids and it is equally significant to observe the absence of the diploids in N. India. Morphological variation similar to S. Indian forms was encountered in the herbarium sheets of the Malayan forms of the species. Apparently, diploids and polyploids also occur in this region. Hence, it may not be wrong to conclude that *O. alismoides* originated in such tropical regions like S. India and Malaya and then migrated to the northerly parts in the range of distribution. In this connection, it is interesting to note that the specimens from China and Australia also look like polyploids.

Grateful thanks are due to Prof. A. C. Joshi, Dr. N. Parthasarathy and to Mr. J. Sinclair, Botanic Gardens, Singapore, for help in various stages of the investigation and to National Institute of Sciences of India for the award of a Junior Research Fellowship.

Kakinada, Y. SUNDAR RAO.
December 18, 1950.

1. Dandy, J. E., *Jour. Bot.*, 1934, **122**, 132. 2. Sundar Rao, Y., *Proc. Ind. Sci. Congr.*, Poona, 1950.

A MUTANT IN ASIATIC COTTON

SEEDS of three pure lines of Asiatic cotton belonging to *G. herbaceum* var. *acerifolium* HSS and *G. arboreum* race *indicum* HSS were irradiated by X-ray from a molybdenom target at 50 KV, 10 ma and 15 centimetre distance for time intervals of 10, 15, 20 and 30 minutes. The plants raised from the treated seeds did not show any change during the first year while one of the progenies of strain 546 from *G. arboreum* race *indicum* HSS irradiated for 10 minutes, had narrow leaves in the second generation. The new variant accessed as SX 507 in the breeding records, was not different from the parent stock in any manner except for the change in the mean values of leaf index which increased from 2·5 to 4·0, and bred true in the succeeding generations.

The inheritance of the narrow leaf mutant SX 507 was studied in crosses made with the parent strain 546. The leaf indicies adopted in interpreting the data were the arithmetic means of index A/C + index A/D[2]. The F1 was intermediate; the two backcrosses gave equal proportions of parental types; and the second generation yielded 1 : 2 : 1 ratio. The summary of the results is given in the above table.

Name of parents	Generation	Total plants observed with indicies			Value of 'P' greater than
		ll 2·3 to 2·7	*Ll* 2·9 to 3·5	*LL* 3·7 to 4·3	
Broad leaf Strain 546 ..		8			
Narrow leaf Mutant SX 507 ..				8	
SX 507×546 ..	F 1		2		
Do ..	Backcross to 546	8	6		0·50
Do ..	Backcross to SX 507		10	9	0·80
Do ..	F 2	58	115	48	0·30

The behaviour is in all respects identical with the one recorded by other workers for factor pair $L - l^2$ in Asiatic cotton series. On this hypothesis, the mutant SX 507 must be interpreted as one in the dominant direction. Since however, almost all the induced mutations recorded in crops have been recessive, the possibility of explaining the inheritance satisfactorily on any alternative hypothesis will also have to be examined. The data will admit interpretation on the basis of a dominant inhibitory factor I present in strain 546, mutating in the recessive direction to i in SX 507 and having a graded effect according to dosage. As no crosses between mutant i and other narrow leaf *L* types have been made and studied, it is not possible at this stage to say which of the two hypotheses is correct.

The occurrence of the mutant progeny in the second year will be a normal one, if the change is viewed as *I* to i but if it is to be explained as a dominant one, the mutation must be regarded as having occurred in a somatic cell affecting both chromosomes, possibly late, just prior to flowering as otherwise the change in leaf lobing must have been noticed in the first generation itself. The strain 546 must have been highly mutable since it yielded new mutants like meristic variant $(m)^3$ and chlorophyll deficient xantha $(chl_2)^4$ when it was irradiated by X-ray twice before. Types belonging to *G. herbaceum* var. *acerifolium* HSS on the other hand were more stable and gave only one mutant albino $(chl_1)^4$. The comparatively larger variability and the numerous races and varieties of *G. arboreum* HSS are probably the result of such small changes induced by severe stress of new environments under which man has been constantly trying to expand cotton growing for his own ends in the past.

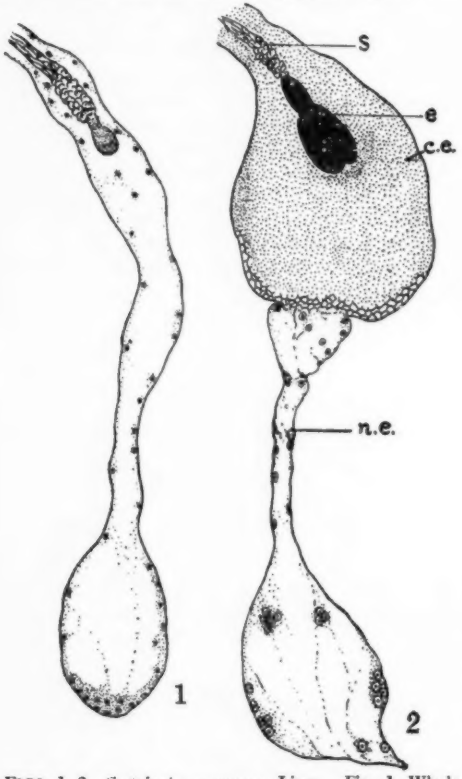
R. BALASUBRAHMANYAN.
Agric. College & Res. Inst.,
Coimbatore,
December 25, 1950.

1. Abraham, P., *First. Conf Cot. Grow. Prob. Ind.*, 1937. 2. Hutchinson, J. B., *Mem. Cot. Res. Stn. Trinidad*, 1934, 7. 3. Ramanathan, V. and Balasubrahmanyan, R., *First Conf. Cot. Grow. Prob. Ind.*, 1937. 4. Balasubrahmanyan, R., *Third Conf. Cot. Grow. Prob. Ind.*, 1946.

THE ENDOSPERM IN *CROTALARIA*

THE occurrence of a free nuclear tubular process in the chalazal part of the endosperm was recently reported in *Cassia Tora*, a member of the Cæsalpiniaceæ.[1] A similar organisation of the endosperm has been observed in several species of *Crotalaria* belonging to the Papilionaceæ. The embryo-sac, after fertilisation,

enlarges considerably growing particularly in length and is soon filled up with a large number of free endosperm nuclei. The nucellus which is massive along the sides and in the chalazal region, is gradually crushed on account of the extensive growth of the embryo-sac, and this results in the formation of a cavity towards the broad chalazal end of the developing seed. Cell formation in endosperm commences late in the micropylar region when the embryo has reached a fairly advanced stage in its development. The chalazal part of the embryo-sac, however, remains free nuclear and is formed into a narrow tubular process which has an enlarged lower end. A considerable number of large free endosperm nuclei are found in the tubular portion whose enlarged lower end is in intimate contact with the chalazal tissue. The cellular portion of the endosperm in the mean time will have extended considerably and occupies the major portion of the seed cavity. The tubular free nuclear portion with its enlarged lower end is found lying twisted and compressed in the free space below the cellular zone. In later stages, it gets completely crushed. The cellular portion of the endosperm is gradually consumed by the developing embryo which in the mature seed occupies the whole of the seed cavity.



FIGS. 1, 2. *Crotalaria verrucosa* Linn. Fig. 1. Whole mount of embryo sac which has elongated considerably showing the embryo and free nuclei of endosperm. × 40.

FIG. 2. Whole mount at a later stage showing the cellular and free nuclear zones of endosperm. × 16.

(*s*, suspensor; *e*, embryo; *c.e*, cellular zone of endosperm; *n. e.*, free nuclear zone.)

The entire embryo-sac can be easily taken out of the developing seeds in various stages of development (Figs. 1, 2), and the whole mounts show clearly the chalazal tubular process. A detailed account of the development of endosperm in several species of *Crotalaria* is being published separately.

My sincere thanks are due to Prof. P. Maheshwari of the Delhi University for his valuable suggestions.

M. ANANTASWAMY RAU.

Dept. of Botany,
First Grade College,
Mysore City,
December 26, 1950.

1. Anantaswamy Rau, M., *Nature* (London), 1950, **165**, 157.

A PRELIMINARY NOTE ON RICKETTSIOSIS IN SHEEP AND GOATS IN BOMBAY STATE

THIS is a preliminary report on an original observation of the author on the incidence of Rickettsiosis in sheep and goats in Bombay State.

The causative organism has been recognised as "Rickettsiæ", inhabitating the tissues of Arthropods which act as vectors. In South and West Africa two species of the organisms, *viz.*, *Rickettsia ruminantium* (Cowdry) and *Rickettsia ovina* have been reported to cause "Heart Water" disease and febrile illness in sheep and goats, but not much work seems to have been done by way of epidemiological, serological and pathological investigations.

The author detected the disease first in a 'merino ram' on the Sheep Breeding Research Station at Suttati (Belgaum), in July 1949. The animals suffered from febrile illness and Rickettsia-like bodies were detected in the monocytes of its circulating blood, which were later confirmed by Dr. H. N. Ray of I.V.R.I. The ticks on the body of the ram (*Hæmophysalis bispinosa*) were found to be carriers in animal tests, since the tick emulsion in normal saline injected subcutaneously produced similar syndrome of symptoms in a healthy sheep and a healthy goat. Also the blood of the diseased ram was observed to be infective to guineapigs

as could be observed from the thermal and scrotal reactions depicted by the healthy guineapigs. Rickettsia were recovered in the blood of experimental sheep and goat as well as in the tunica vaginalis and peritoneal scrapings of guineapigs. This has been mentioned in the Annual Progress Report of 1949-50 of the I.C.A.R. Scheme for the investigation of the diseases in sheep and goats in Bombay State. Peculiar and typical variations in temperature were recorded in the naturally affected and experimental sheep and goats and also in guineapigs.

Detailed findings will be separately reported on completion of the investigations.

S. L. MANJREKAR,

Asst. Disease Investigation Officer, (Sheep & Goats), Bombay State, Poona 3.
January 5, 1951.

ON THE BIOLOGICAL OXIDATION OF SEWAGE

IN continuation of earlier studies,[1-4] it was observed that aerobic conditions and oxidation changes were promoted in sewage filtered through soil, and that the micro-organisms developed during successive replacements of the soil filtrates (in shallow basins, by the fill-and-draw method) were mainly aerobic bacteria, ciliate protozoa including peritrichous ciliates, *e.g.*, species of *Epistylis* and *Opercularia*. and higher organisms such as species of Rotifers. Similar observations were made with 'weak' and 'diluted' sewages as with the soil filtrates, but the development of the colonial ciliates was slow in the former cases. All these types of organisms (including occasionally still higher organisms, *e.g.*, *Aulophorus* sp.) were found to develop rapidly in unfiltered sewage into which air was bubbled. In addition to these organisms, species of *Carchesium* were also noticed in certain activated sludges (*e.g.*, from the Plant at Ambasamudram). Observations showed that among the micro-organisms studied the ciliates were the most efficient in producing effluents of the highest degree of purity.

The occurrence of species of *Opercularia* in sewage under aerobic conditions and in activated sludge lends further evidence to the importance of peritrichous ciliates in the purification process. There seems to be no record about *Opercularia* in the literature bearing on ciliates in India, Burma and Ceylon.[5,6]

The author's thanks are due to Dr. B. R. Seshachar for the confirmation of the identification of *Opercularia* sp.; and to Dr. G. J. Fowler for his keen interest in the work.

Dept. of Bio-Chemistry, S. C. PILLAI.
Indian Institute of Science,
Bangalore,
December 5, 1950.

1. Pillai, S. C., *Curr. Sci.*, 1941, **10**, 84 ; *Ibid.*, **1942 11, 437** ; *Ibid.*, 1949, **18**, 382. 2. —, Gurbaxani, M. I., and Subrahmanyan, V., *Ibid.*, 1947, **16**, 155. 3. —, Rajagopalan R., and Seshachar, B. R., *Ibid.*, **1947, 16,** 254. 4. —, and Rajagopalan. R., *Ibid.*, **1948, 17, 329**. 5. Bhatia, B. L., "The Fauna of British India, including Ceylon and Burma : Protozoa : Ciliophora," Taylor and Francis. Ltd., London, 1936. 6. Private discussion with Dr. B. R. Seshachar, Professor of Zoology, Central College, Bangalore.

DIRECTORY OF INTERNATIONAL SCIENTIFIC ORGANIZATIONS PUBLISHED BY THE UNESCO

THE Directory, which contains 240 pages, groups the International Organizations in three main chapters—basic sciences, applied sciences, and miscellaneous. The applied sciences are subdivided to cover the agricultural, engineering and medical sciences. Under miscellaneous are to be found such bodies as the International Union for the Scientific Study of Population, the International Federation of Library Associations, and the International Scientific Film Association.

At the end of each chapter, under the heading "Regional", are organizations whose activities are limited to a particular geographic area, as for example the European Federation of Agriculture, and the Pan-American Institute of Geography and History.

Under the separate headings, the following particulars are given: a brief outline of the aims of each organization and information on its special activities; information on the governing bodies and officers and members; a list of the Member States or national organizations and individual members; commissions set up within certain organizations with details of their work; special facilities of certain organizaions, such as laboratories and museums, financial resources; the frequency of meetings; provisions governing voting procedure; a list of the periodicals and documents published; relations with the U.N., Specialized Agencies, and other international bodies; an outline of the organization's history; and miscellaneous information, such as date and place of forthcoming congresses.

The Directory is published in English and French. The cost per copy is 6 shillings.

REVIEWS

The Effect of Atomic Weapons Prepared under the direction of the Los Alamos Scientific Laboratory and published by McGraw-Hill Book Company, 1950. Pp. x + 456. Price $3·00.

As the Director of the Civil Mobilization Office (U.S.A.) has stated in the Preface, this book contains a detailed description of the physical phenomena associated with atomic explosions and provides certain basic data which will be helpful in the preparation of practical plans for atomic warfare defences.

The amount of energy produced in the fission of 1 kg. of uranium 235 or plutonium is equivalent to 2×10^{13} calories or 20,000 tons of T.N.T. This corresponds to the energy of the atomic bombs dropped over Japan. At the instant of explosion, the core temperature may be of the order of 1 million degrees, which starts an expanding ball of fire which at ·1 millisecond after zero time may have a radius of 45 ft. and a temperature of 300,000°. Below this temperature the shock wave advances more rapidly than the isothermal sphere. At the lapse of a second, the ball of fire attains the radius of 450 ft. but the shock front is 600 ft. further ahead. Here the overpressure may be higher than 100 lbs. per sq. inch. After ten seconds, the shock wave has travelled 12,000 ft. and has passed the region of maximum damage. Scaling laws apply to such explosions. Hence from a specific atomic explosion, whose state variables, i.e., pressure, temperature and density, can be written as functions of radius and time, the characteristic features of another explosion can be estimated provided the relative releases of atomic energies are known.

The nature of the fire ball and the shock waves for bursts in the air, on the surface of the sea or earth, or under the sea has been fully described, and the destruction caused by them fully illustrated with photographs.

The effect of radioactive contamination after an explosion has been examined over a number of years; it has been found that even in the most heavily contaminated areas the average dosage rate fell to ·3 roentgen per day after a year. The conclusion is drawn that for 1 kg. atomic explosion protection against blast, initial radiation and thermal radiation become practical at a half-mile from ground zero; and that proper precautions may result in a sharp drop in deaths and damage beyond 3,000 ft. or so. Valuable suggestions have been made regarding the nature of these precautions.

Now that many people are thinking seriously about a third world war, this book should be carefully read by all those who are in charge of civil defence and air-raid precautions.

J. C. G.

Modern Gas Turbine. By Arthur W. Judge. Second Edition, Revised. (Chapman & Hall, Ltd., London, 1950. Pp. xii + 388. Price 32 *sh.* net.

The book under review was first published in 1947 and now appears in its second revised edition, bearing testimony to the rapid development of the gas turbine in every field of its application. It gives a very complete and up-to-date picture of the present situation. Moreover, the book offers a very good introduction to the underlying principles of thermodynamics, which are illustrated by reference to practical applications.

Together with a history of the development of the gas turbine which appeared in industry first as an auxiliary unit to the Velox boiler and other thermal installations, the thermodynamic fundamentals are explained very vividly. Due reference is also made here to the first application of the gas turbine as an exhaust turbine in combination with piston engines either of the Otto or the Diesel principle. The pros and cons and the inherent limitations are outlined in the second chapter and a more precise and advanced outline of technical thermodynamics is given in the next chapter. Mention is also made of the combination of the rotary with the oscillating type of heat engine, which is regarded as more and more essential for a certain range of power. The efficiency of the gas turbine and possible effects thereon are discussed in the next two chapters and due consideration is given to the many variables which enter the discussion, such as blade cooling, compounding, reheating, etc. While discussing the closed cycle, valuable information is given regarding power plants which have already been built or which are in preparation now and this scheme is compared with the open cycle. Some mention however could have been made here of the semi-closed

cycle which is discussed later. A whole chapter is devoted to the details of exhaust turbines and their combination with normal piston and especially aero piston engines. A very interesting chapter outlines the aero gas turbine and the principles of air-craft propulsion where the German designs have been mentioned, and also burners and atomizers. The next chapter is devoted to some typical power plants in all fields of application, stationary and non-stationary. Of more than general interest is the chapter on materials for gas turbines and their properties, especially with respect to effects of high temperature, corrosion and scaling. The last chapter reviews recent advances and developments and describes power units of recent design. Some emphasis is placed here on auxiliaries for turbine units such as the fuel system. In two appendices, remarks are made on blade design and blade fixing methods.

The book gives a large number of references, which are of help to the professionally interested reader. It would have been of advantage if the book could have given more attention to the underlying engineering sciences, such as to the principles of heat transfer, and the effects, say, on heat exchanger design. The theoretical aspects of different turbine schemes are discussed in Chapter XI and could have been combined with similar considerations earlier in the book. The same holds for the descriptive part of the book where information on a particular turbine scheme is being found in different chapters. The chapter on exhaust gas turbines could be made shorter, especially since the term 'gas turbine' denotes normally and conveniently a power unit working on its own rather than an auxiliary unit, as is the case with turbosuperchargers.

The book, in short, gives all necessary information to the technical reader who is interested in the fundamentals, the present position, and the future development of the most modern prime mover.

H. A. HAVEMANN.

Dirichlet's Principle, Conformal Mapping and Minimal Surfaces. By R. Courant. (Interscience Publishers, New York), 1950. Pp. xii + 330. Price $4·50.

The name *'Dirichlet's Principle'* was given by Riemann to the assertion that the integral

$$D[\phi] = \iint_G (\phi_x^2 + \phi_y^2)\, dx dy$$

is minimised by a uniquely determined function ϕ with prescribed boundary values. Ever since Hilbert succeeded in proving the existence of a solution of the minimum problem by direct construction, the fascination of Dirichlet's Principle has proved a powerful stimulus for the development of the so-called direct methods of the calculus of variations. This development we owe mainly to Courant who, along with his collaborators, has set up and successfully pursued a programme of using Dirichlet's Principle as a basis for developing general methods of the calculus of variations. The beauty and fruitfulness of this approach may be seen on the one hand in the solution by variational methods of the boundary- and eigen-value problems for elliptic partial differential equations of the second order (*vide*: Courant & Hilbert—*Methoden der Mathematischen Physik*, Bd. II), and on the other in the solution given by Courant not only of the original Plateau problem but also of Douglas' general problem and of related problems on conformal mapping, which forms the subject-matter of the book under review. Here we find a unified account of various investigations relating to minimal surfaces and conformal mapping, treated by variational methods using Dirichlet's Principle. A discussion of this principle and its applications to conformal mapping (Chapters I, II) prepares the way for a thorough treatment of Plateau's problem for simply connected minimal surfaces with prescribed boundary (Chapter III) and Douglas' general problem of a minimal surface of prescribed topological structure bounded by a system of given contours (Chapter IV). Existence-theorems are established and questions such as that of the dependence of the solution on the boundary are analysed. Chapter V contains a variety of theorems on the conformal mapping of k-fold connected domains, on the basis of the methods of the two preceding chapters. In the last chapter two extensions of the theory of minimal surfaces are considered: (*a*) minimal surfaces of least area when the whole or part of the boundary is left free on given manifolds (minimal surfaces with free boundaries), and (*b*) minimal surfaces whose areas are not relative minima (unstable minimal surfaces). Many interesting problems of these two types are discussed. There are, naturally, many problems still remaining unsolved, such as those relating to uniqueness, analytic extension, branch points, etc. Such questions are explicitly formulated and discussed with reference to typical examples which suggest, in some cases, plau-

sible answers as yet unsubstantiated by complete proofs. There is a comprehensive Appendix by Prof. M. Schiffer giving an account of some recent progress in the theory of conformal mapping. The exposition attains a standard of near-perfection in the matter of charm and clarity and one has no hesitation in endorsing the author's claim that the style (of writing) "expresses adequately the balance and tension between the individuality of mathematical objects and the generality of mathematical methods". There is no doubt that this book will exercise a great influence in the further development of an important branch of Mathematical Analysis.

V. R. T.

Fundamentals of the Calculus. By Donald E. Richmond. (McGraw-Hill Book Co., Inc.), 1950. Pp. ix + 233. Price $3·00.

What the pure mathematician means by the fundamentals of differential and integral calculus is very much different from what forms the subject-matter of this book. The publishers' blurb and the author's Preface give a clear idea of the scope and limitations of the treatment and the class of students for whom the book is written. There is a large class of students of physics, who are more interested in the march of salient ideas in physical theories than in rigorous deductions, and although they can get on, without knowing much mathematics, they find themselves helpless if they do not know an irreducible minimum of calculus, trigonometry and conics. The book under review provides that irreducible minimum.

There are seven chapters introducing the reader systematically to numbers, functions and graphs, derivatives, integration, logarithmic and exponential functions, complex numbers and trigonometry and lastly the calculus methods are used in explaining a few basic properties of the conics. There are a good many illustrative examples, followed in each chapter by exercises for the student. Answers to the exercises are given in the end. The reader for whom the book is written will find the exposition in each chapter lucid and stimulating.

All serious students who are concerned with questions of growth, form and change—whatever be their special fields of study and investigation—have to be familiar with certain elementary mathematical methods and operations. Ignorance of these is as bad as illiteracy with regard to several domains of knowledge. Books like *Fundamentals of the Calculus* play a useful part in the mathematician's campaign against such illiteracy. The printing of the book is excellent which probably accounts for the price, which is rather high for the Indian reader.

V. V. N.

Ultrasonics. By Dr. P. Vigoureux. (Chapman and Hall, Ltd., London), 1950. Pp. vi + 163. Price 25 *sh.*

Ultrasonics is a subject of recent growth, a subject which could be said to have taken its birth in the stress and toils of the first World War:—it is a war baby. Though necessarily, in the beginning, much of the work in Ultrasonics was of an applied character, applied in the detection of submarines, icebergs and obstacles in general under water, nonetheless, the subject has made great advances during the last thirty years. In the early days, short reviews appearing in scientific and technical journals, were the only accounts relating to the development of the subject. The first systematic book to appear on the subject was that of Bergmann in 1937, an English translation appearing in the following year. Hiedemann's later book, published in 1939, was unfortunately not generally available outside Germany, as World War II intervened. Bergmann has already (1949—fifth edition) brought his book up to date in a completely revised and enlarged edition. In the intervening ten or twelve years, the subject has expanded so vastly that one could judge its vastness from a comparison of the two editions of Bergmann's, namely, those of 1937 and of 1949; the former lists 483 references while the latter, 2,322 references in their respective bibliographies.

Except for an English translation of Bergmann's treatise (1937), there has been no systematic attempt made to write a comprehensive book on Ultrasonics in English, till 1950. Carlin's *Ultrasonics* (1949) cannot be said to cover its fundamental aspects as it deals more with the engineering side and thereby forms a supplement to the earlier book of Bergmann.

Dr. Vigoureux, the author of a well-known treatise on *Quartz Oscillators and Their Applications*, has now set to himself the task of bringing home the subject to a larger number of persons than pure researchers and specialists in the field of Ultrasonics, by a comprehensive book on it. In the introduction to the book, the author states that the object of the book is "to introduce the reader to the technique and the simpler aspects of the theory of propagation of Ultrasonics in fluids". He has further limited

the task of keeping "the theoretical treatment as simple as possible, consistent with meeting the requirements of what explanations of phenomena are available to date". In these respects, Dr. P. Vigoureux has succeeded very well in the clarity with which he has written the book.

The book consists of topics on (1) Generation, (2) Propagation, (3) Observation, (4) Gases and (5) Liquids. Proceeding from the fundamentals of the generation of Ultrasonics, the author describes the several methods used for observation and measurement of the waves in fluids, both in respect of velocity and of absorption.

The absence of any chapter dealing with applications of Ultrasonics would indicate that this is more a book dealing with results of pure research than an account of its application in various fields.

A bibliography of some of the more recent important papers is given and the reader is referred to Bergmann's treatise for further and fuller details.

As an introduction to the subject of Ultrasonics and as a text-book for degree classes, the book is of great value and satisfies a demand on the part of students who do not require either a greater theoretical treatment or even an account of the applications of Ultrasonics in fields other than physics. The book amply fulfils the object with which it has been written. S. P.

Ionisation Chambers and Counters. By D. H. Wilkinson. Edited by N. Feather and D. Shoenberg. (Published by the Cambridge University Press in the Cambridge Monographs on Physics), 1950. Pp. xii + 266. Price 25 *sh.* nett.

This book is a welcome addition to the rather scanty literature on the subject. All the fundamental processes underlying the operation of ionisation chambers and counters are still not very clearly understood and, in some cases, the point of view of different workers are different. Quite naturally, the author takes a view to which he subscribes and some may like to label such a line of approach as rather biassed. But, this line of approach is inevitable in a field where our knowledge is yet not fully established. Considered in this light, the book provides a very readable and a thorough account of the subject.

The book is divided very logically into eight chapters. After an introduction on classification and devices, the phenomena of ionisation and the behaviour of counters are dealt with. This is followed by the electrostatics of pulse formation. Then, the ionisation chamber, the proportional counter, the Geiger Counter and speed and statistics come up for treatment in separate chapters. There is a very valuable list of references at the end and an index. The book, therefore, forms a real text-book to be read by everyone who uses these devices and the references provide further material. It is inevitable that the present-day Honours student in pure physics must have a thorough grounding in this field in view of the importance of ionisation chambers and counters in nuclear physics. Hence, the book can be strongly recommended to students also. The printing and get-up of the book are excellent.

S. V. CHANDRASHEKHAR AIYA.

Input Impedance of a Slotted Cylinder Antenna. By C. A. Holt. Engineering Experiment Station—Circular Series No. 59. (Published by the University of Illinois, Urbana, U.S.A. *University of Illinois Bulletin*, Vol. 47, No. 51), March 1950. Pp. 50. Price $·40.

Slot cylinder antenna are at present used in the U.S.A. commercially for F.M. broadcasts and are likely to be of use for television. An analytical method for determining the input impedance of such an antenna is very desirable and useful. In the paper under review, the author attempts a solution of the problem in terms of the dimensions of the antenna and wave-length. The method is limited in application only to cases in which the ratio of diameter to wave-length is less than 0·2. The experimental results appear to agree well with the calculations. The methods of calculation are obviously approximate. In the experimental procedure, only one antenna was used and the slot length was varied by soldering short circuiting copper plugs along the slot. This procedure is not very desirable in the frequency range of 400 to 1,116 mcs/s. It may be helpful to compare the results obtained with those from separate antenna with different slot lengths. Reports of publications of this type should find a place oftener in the journals of our country.

S. V. CHANDRASEKHAR AIYA.

Structural Chemistry of Inorganic Compounds. By Walter Hückel. Translated by L. H. Long. (Elsevier Publishing Co., Inc., New York), 1950. Pp. vii + 437. Price $ 9·00.

This English translation of Prof. Hückel's original monograph *Anorganische Strukturchemie* is perhaps one of the best books on this

topic published in recent times. As the title implies, the work is not intended to be useful as a text-book of general chemistry but contains a splendid review of the fundamental theries of molecular structure as applied to both organic and inorganic compounds. The subject-matter is divided into two parts of which Book I entitled *Stoichiometry and Systemisation* deals with a few important topics, *e.g.*, the phlogiston theory, the laws of chemical combination and the concept of chemical affinity (Chapter 1). The next chapter presents in some detail the general classification of inorganic compounds as based on the periodic law, modern views on valency, the co-ordination theory and different bond types in simple and complex molecules. The author has assembled information on the state of bonding in compounds of higher order and a number of controversial topics regarding the application of Werner's theory to such compounds are discussed to emphasize the necessity of structural thinking in inorganic chemistry. This is followed by an exhaustive and critical review on the co-ordination theory of complex compounds. The data are arranged systematically and classified in two parts. Part I is devoted to the structure of mononuclear complexes. Spatial structures of such molecules with different co-ordination numbers are discussed along with an instructive review on the inner complexes and polymeric co-ordination compounds.

In Part II a critical evaluation of the data regarding polynuclear complexes is given. This includes the hetero- and polyacids, the metaphosphates and the silicates. The method of assembling the data, its system of classification, the points of emphasis and text contexts—while resembling each other in some respects, are also distinctly different from the existing literature.

Book II, *Atomic Structure and Chemical Bonding*, deals with the comparative examination of atomic structure from the point of view of the periodic classification, and elaborates on the discussion of various physical theories concerned in the study of the extra-nuclear structure of the atom. This is followed by detailed information about the experimental methods adopted in the investigation of chemical bonding. Simple bonds between like and unlike atoms, multiple bonds and the phenomena of isosterism and mesomerism as applied to (electronically) similar compounds predominate among the types of structures discussed in the last chapter, along with the translator's note embodying a critical discussion on Pauling's theory of resonance in inorganic compounds.

It would be difficult to find a more adequate and useful assemblage of information about the subject than is present in these 437 pages. It is an original and erudite study of chemistry from quite a new angle.

According to the author, the work is intended to make it clear that a study of inorganic chemistry in conjunction with organic chemistry provides a magnificent and internally consistent over-all picture of the structure and constitution of matter. The book lives up excellently to this description and should serve well to stimulate the interest of students and teachers of chemistry in the subject.

G. S. DESHMUKH.

An Introduction to the Embryology of Angiosperms. By P. Maheshwari. (Publishers: McGraw-Hill Book Co., Inc., New York, U.S.A.), 1950. Pp. x + 450. Price $6·00.

Since the publication of Coulter and Chamberlain's compendium dealing with the embryology of angiosperms in 1903, the subject has progressed and ramified prodigiously both in academic and in applied aspects. Within the last 50 years, plant embryology has become almost an independent science. All countries with any record of scientific achievement have contributed to this rise in its status; and the literature of such contributions has appeared in all the major languages of the world. As a consequence, we have now an unmanageably large output of information which called for organization, integration, and critical evaluation. It is gratifying that so distinguished a worker in the field as Prof. Maheshwari has come forward to render this service.

After giving a comprehensive resumé of the origins and development of the science of plant embryology from the time of Amici to that of Schnarf, Prof. Maheshwari has devoted seven chapters to the elucidation of the development of the male and female gametes from the moment of their inception right through fertilization, endosperm formation, and embryo development. The next two chapters deal with the phenomena often accompanying the production embryos,—apomixis and polyembryony. Applied aspects of plant embryology are treated in two chapters: its relation to taxonomy and its experimental prospects. In the final chapter, we learn about the contribution of embryology towards an understanding of the phylogeny of angiosperms. At the end of every chapter is given a selected and up-to-date bibliography.

Prof. Maheshwari's style of presentation is engagingly lucid and bright, and authoritatively

accurate. He has avoided digressions and controversy so as to make the book acceptable to the general botanist not interested in special details. To the college student, the book should prove an invaluable companion. To the teacher, it is the only source of cumulative information. To the research worker, the book, in addition to directing him towards problems yet to be investigated and providing him with essential preliminary information, provides stimulus for thought and discussion and gives impetus for further work. The publication of such a comprehensive work on this important subject by a distinguished Indian scientist is an event for every Indian to be proud of. The get-up of the book is excellent as usual. B. G. L. S.

Functional Anatomy of the Vertebrates. By Daniel P. Quiring. (McGraw-Hill Book Co., Inc., New York, Toronto, London), 1950. Pp. xi + 624. Price $5·50.

For generations, zoologists had been teaching the comparative anatomy of dead animals without worrying about how these animals lived. But, since the First World War, an outstanding change has come about which has transformed zoology largely from a descriptive to an experimental science. It has now become recognized that animal structures should be taught not merely in the way in which they are built, but also at the same time, in the way in which they function. This book is a welcome attempt at treating comparative anatomy from a dynamic rather than from the old static viewpoint, and in uniting description and fact in such a manner "as to build a series of conclusions that explain details and introduce us to function". Within the limits the author has set himself, the book is well planned and deals with the structure and function of all the organ-systems. There are interesting sidelights on some of the systems based on the author's field work, and a useful appendix giving weights of the body and different organs of 3,581 vertebrate animals. K. N. B.

Tissue Culture Technique. By Gladys Cameron. (Academic Press, New York), 1950. Pp. 190 with 75 illustrations. Price $4·20.

Tissue Culture, like bacteriology, has its own special technique. The early masters, like A. Fischer, dealt with both the theoretical and practical aspects of tissue culture. But with greater advance, tissue culture has developed a technical literature of its own. Hitherto, the best book on the subject was Rhoda Erdimann's *Praktikum der Gewebeflege* which, not only gives details of laboratory operations but also refers to many theoretical details.

The book under review is also written by a lady and has undergone two editions which, in itself, speaks of its value. The material is well organised, clearly presented and pruned of all superfluous details. Emphasis has been laid throughout on the practical side, *e.g.*, Appendix C gives the list of materials required for tissue culture with addresses of firms supplying them. Chapter XVII describes in 8 pages the histological technique indicating only what pertains to tissue culture. The chapter on Photomicrography has been contributed by Grand, a specialist in this field. Phase contrast microscopy has been briefly but clearly described. Prof. Chambers, as a master on the subject, offers an illuminating chapter on his own minomanipulator coupled with a special inverted microscope. The book is printed on art paper and is well bound, so that the price, 4 dollars, seems most reasonable.

To all interested in tissue culture, Miss Cameron's book is most indispensable.

S. MAHDIHASSAN.

Indian Concrete Journal: *Special Number. International Engineering Conferences.*

At present only 6 per cent. of the entire water available in the country is being used for productive purposes. There are nearly 134 million acres of land suitable for cultivation. Plenty of man-power is available in the country to cultivate these lands provided the water which is now running to the sea is made available to the land during the long breaks occurring between successive rainfalls. The huge reservoir projects planned for this purpose have been described in great detail in this Journal. River valley projects really mean steel and concrete. The part concrete has to play in the execution of many schemes has been well brought out by the articles in the Journal.

The editorial staff deserve to be congratulated on the timely issue of this Special Number during the International Engineering Conferences.

The usual high standard of the Journal has been kept up. N. S. G.

The Pasteur Institute of Southern India, Coonoor. Annual Report of the Director for 1949-50. (Diocesan Press, Madras), 1951. Pp. 1-66.

The Report deals with (1) routine activities, and (2) research.

Salient features of (1) are: (*a*) Production and distribution of A.R.V. and treatment of cases that visit the Institute; (*b*) Examination of pahological materials for clinical diagnosis.

Research activities included the following: (a) Superiority of Semple's 5% vaccine to 1% vaccine, which was used during 1912-24, was shown by analysis of mortality rate of the treated cases from both groups; (*b*) Phenol-killed liquid cultures of *V. cholera* vaccine of both sub-types, Intaba and Ogaura, were found not inferior to agar culture vaccine of the same; (*c*) Receptor Destroying Enzyme (RDE) of both sub-types of V. cholera isolated from strains from same epidemic and in different epidemics obtained from Madras and Bengal showed variations when tested by hæmagglutination titration; (*d*) Effect of BAL on cobra venom *in vitro* and *in vivo*; (*e*) Significance of fusospirochætes in gastro-intestinal tract and associated clinical syndrome and response to arsenical or penicillin therapy; (*f*) Field and laboratory investigation of an outbreak of influenza in Nilgiri District and Madras City in 1950; (*g*) Continuation of animal experiments with pathological materials from cases of Tropical Eosinophilia indicating definite lesions in the lungs of guineapigs.

K. P. MENON.

SCIENCE NOTES AND NEWS

Tata Institute of Fundamental Research Bombay

The new session of the Institute begins on the 1st July, 1951. Admissions will be made for advanced study and research in Mathematics and Physics. A number of research Studentships of the value of Rs. 175 per month are available for research in (1) Modern Algebra, (2) Function Theory and Fourier Analysis, (3) Differential Geometry, (4) Statistics, (5) Quantum Mechanics, (6) Cosmic Radiation and (7) Nuclear Physics. Research students may register for the Ph.D. of the University of Bombay or of any other Indian University. Hostel facilities are available.

Persons holding an Honours degree in Physics or Mathematics or possessing equivalent qualifications are eligible for admission.

Applications for admission on the prescribed form (obtainable gratis on request) together with a fee of Rs. 2 should be sent to the Registrar so as to reach him on or before the 15th June 1951.

Scholarships for Engineering Apprentices

Engineering graduates from Commonwealth countries, including India, will be eligible to take part in a scholarship scheme which provides a thorough engineering training at factories of the Brush-Associated British Oil Engines Group of Companies (Brush-ABOE), Britain's largest manufacturers of Diesel engines and world-wide suppliers of electrical equipment. It will allow for two years' study of the products and methods of production of the Group and will provide technical experience of considerable value.

A free return passage from the apprentice's home to Britain will be provided together with additional travelling expenses. The apprentices from the Commonwealth countries will receive the same wages as those paid to other graduate apprentices at present working at the Group's factories.

Steps are being taken to bring this offer to the notice of the appropriate authorities in South and South-East Asia through the Council for Technical Co-operation, which had been set up under the Colombo Plan.

Research Degree Awards

Shri. Onkar Nath Mehrotra, M.SC., has been awarded the Ph.D. Degree of the Banaras Hindu University for his work on "Physiological Basis of Drought Resistance in Sugarcane". The thesis was evaluated by Profs. Bernard S. Meyer and Charles E. Olmsted, U.S.A., and Dr. K. N. Lal, of the Banaras Hindu University.

Sri. K. Subramanyam, M.SC., has been admitted to the Doctor of Science Degree of the University of Mysore, for his thesis on "Embryological Studies in Certain Families of Campanulatæ and the Melastomaceæ".

New Library Services for India

A public library of a new kind—especially designed to meet the needs of readers using books for the first time in their adult lives—

is to be opened shortly in Delhi. The institution is the result of an agreement between the Government of India and the UNESCO, providing for a pilot project to show how public library services can effectively support literacy and adult education campaigns.

Postwar Scientific Bibliography for Indonesia

A Medical Bibliography for the period 15th August 1945 to 31st December 1950, has been issued as O.S.R. Bulletin 9, from Indonesia.

Coloured Diamonds from Cyclotron

Red, green and black diamonds are coming out of Birmingham University's 300-ton cyclotron, which is altering the colour of ordinary diamonds in this way for the first time in Britain.

Changing the colour of diamonds in the cyclotron takes only a few minutes. Prior to this, red, green and blue diamonds were obtained for research from the British Atomic Energy Research Establishment at Harwell, where the coloured diamonds were produced more slowly in the atomic pile.

—*By courtesy to the B.I.S.*

Coal Tar Creosotes of Indian Origin

Toxicity tests carried out with *Polystictus sanguineus* in the Forest Research Institute, Dehra Dun, indicate that the high boiling fractions of creosote are more toxic than the lower boiling ones and that it is not necessary to specify any limits for acid content in creosote specifications. Accelerated field tests also indicate that heavier creosotes and creosote fractions are more toxic and more permanent. Further, the results of accelerated service tests indicate that if 75 : 25 or 50 : 50 mixtures of creosote-fuel oil are used, considerable latitude is possible in creosote specifications. This confirms the soundness of the practice of using creosote-fuel oil mixtures in this country.

Entomological Society of India

The following Office-bearers were duly elected for 1951-52: *President*: Dr. E. S. Narayanan, New Delhi. *Vice-Presidents (from ex-Presidents)*: Dr. H. S. Pruthi, New Delhi; Dr. K. B. Lal, Kanpur. *Vice-Presidents (New)*: Dr. I. M. Puri, Delhi; Dr. K. N. Trehan, Ludhiana. *Councillors*: Shri. S. Ramachandran, Coimbatore; Dr. V. P. Rao, New Delhi. *Chief Editor*: Shri. Y. Ramchandra Rao, Bangalore. *General Secretary*: Dr. S. Pradhan, New Delhi. *Joint Secretary and Treasurer*: Shri. S. N. Chatterjee, New Delhi.

The Royal Institute of Chemistry of Great Britain and Ireland: N.I. Section

At the Annual General Meeting of the Northern Indian Section of the Royal Institute of Chemistry, held on 3rd March 1951, the following Office-bearers were elected:—

President: Prof. T. R. Seshadri; *Hony. Secretary*: Dr. G. S. Saharia.

Prof. C. Mahadevan

The Syndicate of the Andhra University has awarded Prof. C. Mahadevan, Head of the Geology Department of the Andhra University, the Travancore-Hyderabad Travelling Fellowship to study recent advances in U.S.A. in pure and applied Geology. The U.S. Government have given Prof. Mahadevan the Fulbright Travel Grant and the Committee on International Exchange of Persons have invited him as a visiting scholar in the exchange visitor program.

Scientific Expeditions to Australia

The High Commissioner for Australia in India has advised that whenever any scientific expedition, whether Governmentally or privately sponsored, intends to visit Australia, prior intimation to this effect may please be given to him. This would enable the High Commission to inform the Australian Commonwealth Scientific and Industrial Research Organisation, who will, if required, be glad to make arrangements for its officers to assist the expedition to the fullest extent.

ERRATUM

Vol. 19, No. 10, October 1950, p. 311, in the Paper "Electro-Deposition of Metals and Alloys from Cyanide-Free Baths, Part II: Copper from Ethanolamine Solutions":

Column 2, line 1:

1×10^{-33} to 10^{-35} N *should read as* 1×10^{-10} to 10^{-13} N

Secretary: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc. Editor: G. N. Ramachandran, M.A., Ph.D, D.Sc., F.A.Sc.
287-51 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for the Current Sciences Association, Bangalore

JOURNAL OF SCIENTIFIC & INDUSTRIAL RESEARCH

ANNOUNCEMENT

The schedule of advertisement charges in the **Journal of Scientific and Industrial Research** has now been raised, and the new rates come into force from **August 1949.** The revision will be without prejudice to existing contracts and will take effect after the expiry of the contracted period.

The revised rates are as follows :

	Full page	Half page	Quarter page
12 Insertions	Rs. 500	Rs. 275	Rs. 150
6 Insertions	Rs. 275	Rs. 150	Rs. 90
1 Insertion	Rs. 50	Rs. 28	Rs. 18

Advertisements in colour: (Rs. 15 extra per page per colour)

FAVOURED POSITIONS (Full page 12 insertions only)

2nd and 3rd cover pages and pages facing reading matter	Rs. 600 each
4th cover page	Rs. 750

For particulars apply to :

EDITOR

JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

"P" Block, Raisina Road, NEW DELHI—3

FIVE

reasons for using

'ANALAR' REAGENTS

1 They conform to published standards of purity.

2 Their labels show maximum limits of all likely impurities.

3 They are packed under carefully controlled conditions.

4 Their use eliminates 'reagent errors'.

5 They are standard analytical materials in laboratories undertaking important and responsible work.

THE BRITISH DRUG HOUSES LTD.
B.D.H. LABORATORY CHEMICALS GROUP
POOLE ENGLAND

BRITISH DRUG HOUSES (INDIA) LTD.
P.O. BOX 1341 BOMBAY.
P.O. BOX 9024 CALCUTTA.